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Power in a Wholesale Bakery

IDEAL ISOLATED EQUIPMENT OPERATED BY WARD & WARD, BUFFALO, FOR DIVERSIFIED REQUIREMENTS; DETAILS OF NOVEL BATTERY-CHARGING SWITCHBOARD

WHILE WE CONTINUALLY HEAR complaint of the present-day high cost of living, we seldom consider the advantages and conveniences now enjoyed as compared with those days, when many of our daily necessities could be purchased cheaper than now. This is especially true of those commodities used in our homes.

Less than a generation ago, it was customary for the housewife to bake bread once, twice or even 3 times a week, depending upon the number of mouths to be fed, work which, in each case, required nearly a whole day's time, to say nothing of the over-heated kitchen in which she was obliged to work. When not inclined to do her own baking, she could obtain her bread, cakes and pastry from some nearby bakery, whose cleanliness, and the purity of whose products were a matter of question. All of these disadvantages have, with the advent of the large wholesale bakeries, practically disappeared, so that now all home baking may be eliminated, and crisp, fresh, bread wrapped and sealed, and delicious pies and cakes may be purchased at any grocery store.

Few have the opportunity to inspect one of these large bakeries, which instead of supplying the needs of a small community, serve thousands of families within a radius of many hundred miles, with not only their bread, but also cakes, pies and biscuits. And it was not only a pleasure but a surprise to the writer when, upon a recent visit to the new bake shops of Ward & Ward, at Fougern and Bartell Sts., Buffalo, N. Y., he observed

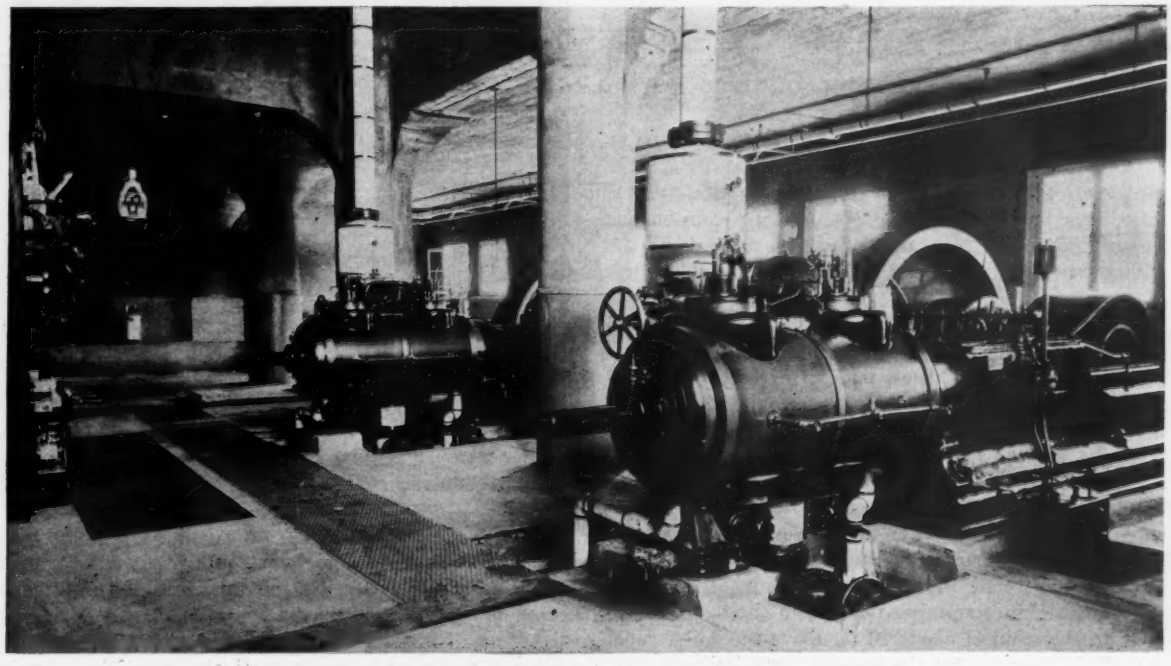


FIG. 1. ENGINE ROOM, WARD AND WARD BAKERY

the modern manufacturing methods, the employment of the purest of ingredients and an extreme cleanliness which overtops that in the majority of private kitchens. By the application of modern machinery, no flour, sugar, butter, flavoring extracts or other ingredients used are ever brought in contact with human hands, and not until the bread, cakes or biscuits have been wrapped and sealed by machines for that purpose are they touched by anyone. It is due only to the perfection of modern machinery, electrically operated and controlled, that such satisfactory results as found in this bakery are obtainable.

As a few examples of the precautions taken to serve their customers with goods of but the highest purity, may be mentioned the large air conditioner found on the upper floor of the 5-story structure, which washes and filters all the air supplied to the 3 upper floors where all the mixing of doughs and other initial processes are carried on; the cleansing of the flour is accomplished

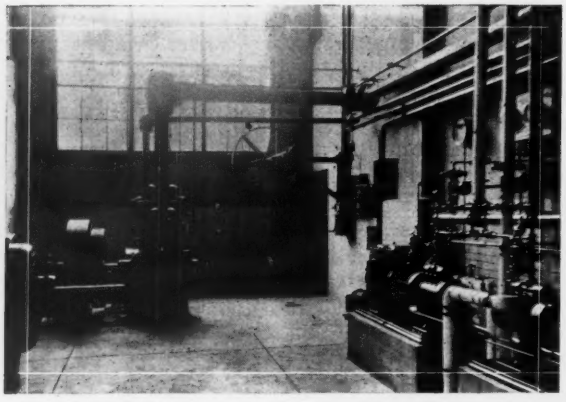


FIG. 2. CORNER OF ENGINE ROOM SHOWING REFRIGERATING MACHINES AND VACUUM PUMPS

by passing it through silk of the smallest mesh; the installation of cooling rooms for preservation of the butter, eggs, flavoring extracts, etc., and the maintenance of constant temperature and humidity throughout the building, checked by recording thermometers and hygrometers.

As may well be expected, to supply the diversified requirements of an industry of this nature, a plant capable of furnishing light, heat, power, refrigeration, compressed air and water is necessary, as without such service little, if anything, could be accomplished.

Heat Supply

A LARGE SECTION of the basement of the building has been set aside for the power plant, the mechanical and electrical repair departments and garage.

Coal is delivered in cars onto a spur of the New York Central Lines running parallel to the boiler room, but at an elevation of about 10 ft. above the boiler room floor. This spur is, for the greater part, built on concrete-steel piers, so that the cars may readily be run over the hopper of a Webster coal crusher located below and the coal dumped therein and crushed to the required size. As yet, the entire coal and ash handling equipment is not installed, so that after the coal is crushed, it is at present necessary to wheel it from the crusher discharge and dump it into a pit where it is picked up by buckets of a Webster elevator and raised to the spout of a chute, which may be swung to deliver to one stoker hopper or the other. At the present time, all ashes are handled by hand.

Steam for heating, power and manufacturing purposes is generated in 2 Heine water-tube boilers, each rated at 300 hp. and is maintained for ordinary operation at a pressure of 145 lb. gage. The furnaces of these boilers are equipped with Detroit stokers, which receive their coal supply from the overhead chute mentioned above.

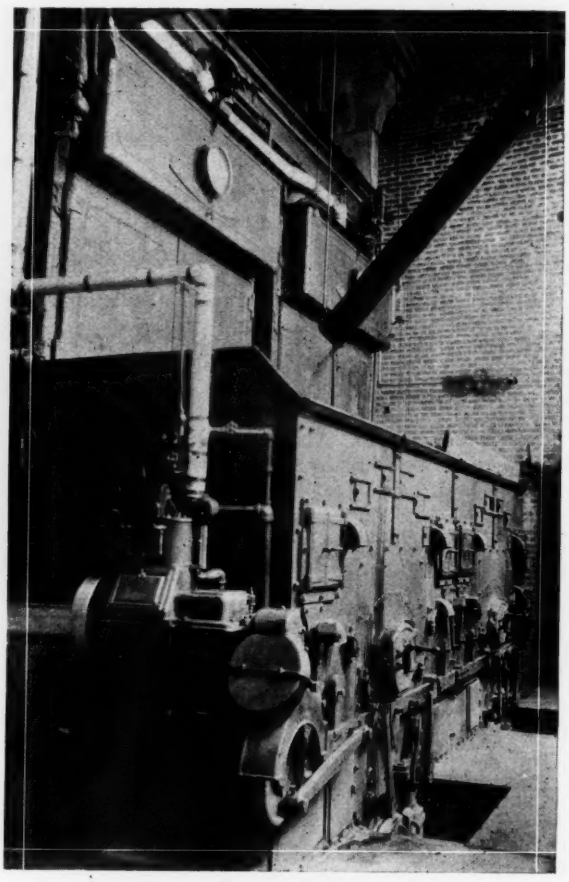


FIG. 3. VIEW IN BOILER ROOM

The boilers are also provided with a Keiley & Mueller damper regulator, and for the proper disposal of the products of combustion, are connected to a 150-ft. brick stack.

In addition to the boilers, the boiler room and adjacent pump and heater room contain a suction tank, Paddock Double Filter, blowoff tank, cushion tank connected to the lines of the house water supply, drip receiver, small motor-driven air compressor, a No. 700 Cochrane metering heater, a vertical motor-driven sump pump, the necessary house and boiler feed pumps, and a Goulds 278-ft. deep-well pump used for the general cooling water supply.

To prevent the drawing of too great a quantity of water at any one time from the city water mains, a Buf-

falo ordinance requires that all industrial plants taking water from these lines install a suction tank, from which to pump the local supply. From this tank, which is equipped with an automatic float valve, the water is pumped through the Paddock filter, containing 2 beds of powdered emery, either to a 10,000-gal. service tank or to the heater, as may be required or desired. Or the piping is so arranged that if necessary to do so, the water may be pumped directly from the suction tank into the boilers.

Separate pumps are used for the delivery of ice water for domestic and manufacturing purposes.

All pumps and engines operate noncondensing, thus affording an ample supply of low-pressure steam for boiler feed heating, manufacturing and house heating purposes. Two American Steam Pump Co.'s simplex vacuum pumps equipped with Dunham regulators and located in the engine room are used in connection with the heating system, which is of the vacuum type.

Engine Room

Thus, as shown in Fig. 1 contains 2 Skinner Universal Unaflow steam engines each direct connected to a 200-kw., 120-v., Westinghouse direct-current generator, operating at a speed of 200 r.p.m. the 2 vacuum pumps mentioned above, and a 12-ton York ice machine belt-driven by a 25-hp. motor, the speed of which can be varied from 500 to 1000 r.p.m.

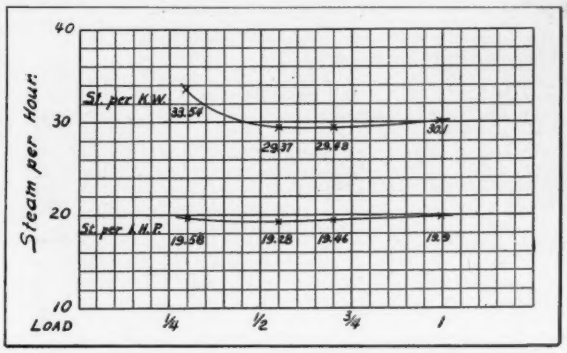


FIG. 7. STEAM CONSUMPTION CURVE OF UNAFLOW ENGINE

Original specifications of this plant called for 2 200-kw. and 1 100-kw. 4-valve engines, the desire being to have the smaller unit operate during light-load periods. On going over the guarantees on the Universal Unaflow engine, however, it was found that a 200-kw. unit of this type operating on the light day load would give better economy than a 100-kw. 4-valve counterflow engine on the same load, so the small unit was not purchased.

Two other Universal Unaflow engines of the same size were purchased at this time for another plant operated by the Ward baking interests; and, inasmuch as the Unaflow engines were more expensive than the 4-valve counterflow engines, on which the purchasers had received quotations, the additional cost of the Unaflow engines was divided by the guaranteed steam saving per indicated horsepower hour, and the contract was so drawn that a penalty of $314 was to be exacted for each pound of steam any of the 4 engines consumed in excess of that specified in the manufacturers' guarantees.

It was decided to make a test on only one engine, and for this purpose, the generator was shipped to the plant of the engine builders and the test made by a representative of the supervising architect and engineer, C. B. Comstock, New York City. As the penalty for each pound of steam consumed per engine above that specified by the builders' guarantees was as mentioned above, the test on this single engine, therefore, provided for a penalty of $1256 for each excess pound of steam consumed.

Tests were made at 4 different loads, and it was found that the engine tested came within the guarantees at every load. From the steam consumption curve shown in Fig. 7, and plotted from the results of this test, it will be noted that the steam rate per indicated horsepower-hour is practically flat and the steam rate per kilowatt-hour, especially at low load, comparatively low.

Friction loss, including windage of generator, was but 3.4 per cent, thus making the mechanical efficiency of the generating set 96.6 per cent.

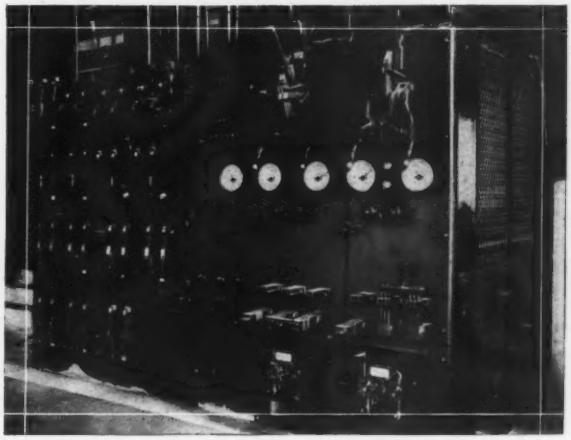


FIG. 4. MAIN SWITCHBOARD

Directly back of, and perpendicular to the center lines of the engines, is the main switchboard built up of 5 black slate panels, 2 of which are completely equipped machine panels, the third reserved for an additional generating set (foundation space of which has already been provided), while the last 2 are for the control of the feeder circuits. Instead of using ordinary knife switches for feeder control, single-pole circuit breakers are employed, resulting in better protection of the machines, a minimum line disturbance at the time of over load or short circuit, and a considerable saving in copper.

Utilization of Power

The air compressor mentioned above is used to maintain a pressure in the cooking oil delivery lines. This oil which is used in the baking processes is brought to the plant in regulation tank cars upon the same siding as the coal cars and by means of a system of piping is transferred by gravity to 6 by 25-ft. storage tanks located in the basement of the building. After the tanks are filled a pressure of 80 lb. gage is automatically maintained as long as there is oil in the tank and system.

Before being delivered to the storage tanks the air, in compliance with a U. S. Government requirement, is

first passed through a water filter, consisting of a small tank horizontally suspended and approximately half filled with water. Air coming from the compressor is caused to pass through the water in the tank before gaining access to the space above so that it is impossible for any air not washed and filtered to come in contact with the oil.

Electrical energy is distributed over lines carried in iron conduit and is utilized for the operation of the electrically-driven pumps, shop machinery, charging of the storage batteries of the company's fleet of automobiles and general artificial illumination of the building.

Each floor of the building and in some instances each department is fed by an independent set of feeders terminating at an individual panel from which the circuit is subdivided and distributed to the various machines on that particular floor or department. The distribution panels are in general appearance and size the same as the feeder panels of the main switchboard, and are surrounded by iron grill work so that none but authorized persons may come near them.

All motors are of Westinghouse make controlled by the Sundh Electric Co.'s automatic starters. On the conveyors and other motor-driven machines, ordinary standard automatic controllers equipped with Sundh current limit relays are used, by means of which the question of the proper time of acceleration is entirely taken out of the hands of the operator. The personal equation is thereby entirely eliminated and as a result the liability of damage to machinery and burn-out of motors, controllers and fuses is reduced to a minimum and greater efficiency of plant operation obtained.

Garage

One of the interesting features of this installation is the garage used to house the company's fleet of about 100 electrically-operated delivery cars and the adjoining charging room in which is located the switchboard controlling the individual charging circuits.

When brought in for repairs, or charging, each automobile is backed up to its allotted space on the floor of the garage where, by means of an individual plug and connection the batteries of the cars, which are of the new Edison type and which may, therefore, be directly connected across the line without the insertion of any additional resistance, may be charged.

The charging switchboard, which is the product of the Cutler-Hammer Mfg. Co., consists of 7 floor-mounted self-supported steel frames, 6 of which carry 7 duplex sections each, while on the central panel are mounted 6 duplex sections with a main meter section. Each section carries the parts for the control of the charging of the batteries of 2 cars, consisting of a low current circuit breaker, battery fuses, pilot light, light fuse, resistance short-circuiting switch and a special double-pole, single throw knife switch which acts both as a main and meter reading switch.

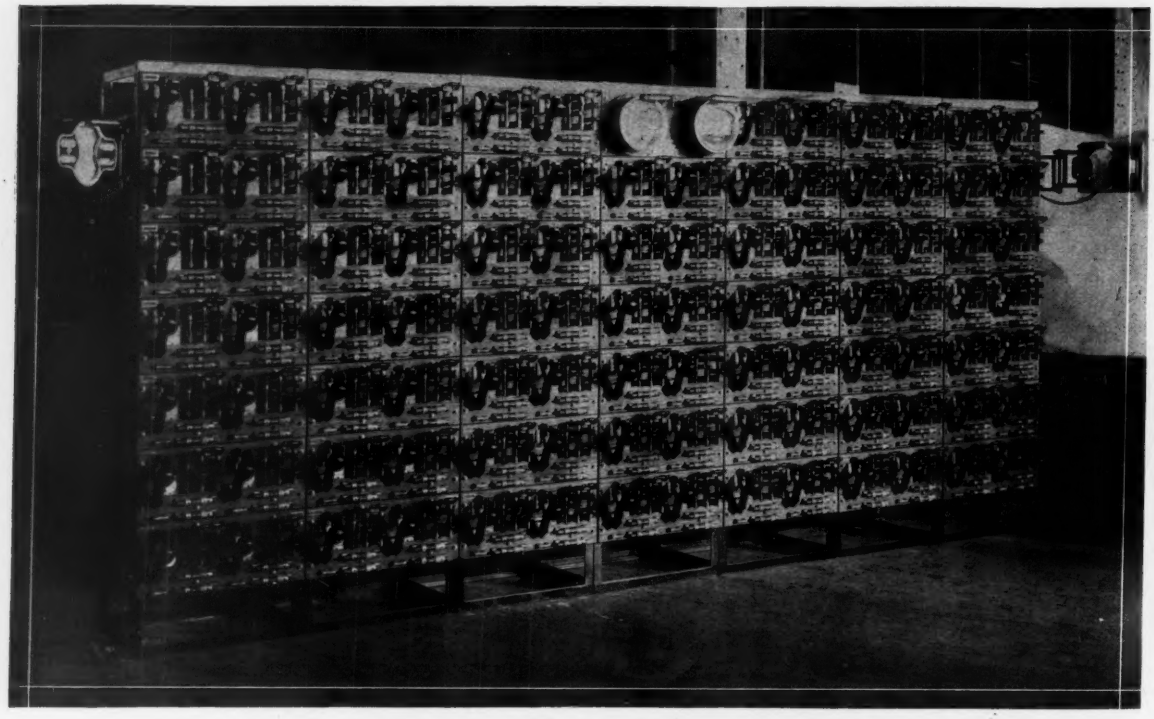


FIG. 5. BATTERY CHARGING SWITCHBOARD

Edison, type A-3 batteries made up of 66 cells each, and normally taking 22.5 amp. on a 7 hr. charge are used for the driving of the motors on the delivery cars. When placed directly across the line with 1.67 V. impressed on the terminals of each cell, double normal current will flow, thus requiring a voltage of 110 at the bus bars. This is known as the constant potential method of charging, the idea being to start with a double

normal current which as the battery builds up to line voltage rapidly falls off to a low value, being at the end of 7 hr. possibly 25 per cent of the normal current. By charging the batteries in this manner, the equivalent of a 7-hr. normal charge at normal rate is obtained without any losses taking place in resistors.

In designing this outfit, provision was made for preventing the battery from receiving an abnormal amount of current in case the bus voltage was high or the battery had been discharged to an exceedingly low point, a condition likely to be met with in winter when slushy streets force the batteries to respond to an extra heavy current demand. To care for this, a small single-pole, single- throw knife switch is provided between the hinge and finger of which is connected a single step of resistance.

battery is connected across the hinges of the switch and one side of the voltmeter to the special clip nearest the switch finger. The other side of the voltmeter is common to one side of the ammeter, and this common point between the ammeter and voltmeter connected to the clip of the other switch blade nearest the switch hinge. This, as will readily be seen, by referring to Fig. 6, allows the reading of the open-circuit battery voltage and, if the knife switch be thrown in so as to engage not only these 2 clips but the switch finger on the right hand side, the closed-circuit voltage of the battery and value of the current flow may be read simultaneously since the ammeter is connected between the other side of the battery and the line. Throwing the switch in as far as it will go disconnects the ammeter and voltmeter from the battery without disrupting the circuit.

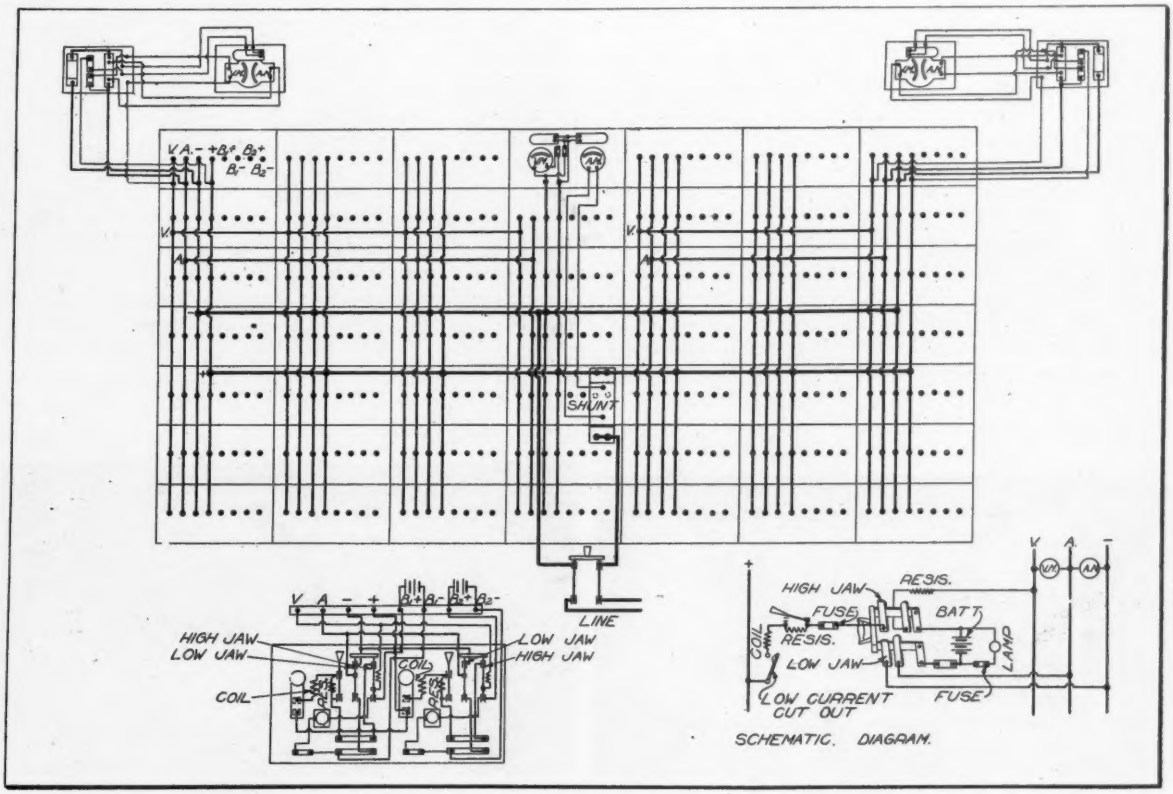


FIG. 6. DIAGRAM OF CONNECTIONS OF BATTERY CHARGING SWITCHBOARD

Upon beginning the charge, this single-pole switch is open, and the low-current breaker closed by hand, which must, however, be held in place until the double-pole knife switch is closed. The breaker will then remain closed and current will flow through the battery. If it is seen that the charging current approximates double the normal rate of the battery, the single-pole switch is kept open, but if the current flow is about normal, the switch is closed and the battery thrown directly on the line. Should a little more than double the normal current flow through the battery, no harm will result as the battery voltage builds up rapidly, with a corresponding falling off in current flow.

A particularly interesting feature about this equipment is the knife switch, which, as stated above, acts both as a main switch and meter-reading switch. The

Upon each end of the board is mounted a Weston Duplex voltammeter, the one on the left indicating the battery current and voltage on all circuits controlled by the first 4 panels while the right-hand instrument cares for the remaining circuits. At the top of the central panel are mounted a 2500-amp. ammeter connected to the main circuit and a 150-v. voltmeter indicating the main line voltage.

Elevators

This equipment consists of 2 Standard plunger type freight elevators, each having a capacity of 2000 lb. and driven by Deane of Holyoke pumps belt connected to electric motors. These motors which are under automatic control start when the storage tank pressure falls to 110 lb., and stop when it reaches 125 lb.

Insulation

IMPORTANCE OF PROVIDING COVERINGS FOR STEAM LINES, BRINE AND AMMONIA PIPES, ETC.

AS all substances conduct or radiate heat to a certain extent, it is impossible to prevent entirely the passage of heat through any substance, although some allow heat to pass through them more readily than others. Substances which allow heat to pass through them readily are called good conducting substances, and those which do not allow heat to pass through them readily, good insulating substances. To insulate, as much as possible, with a suitable pipe covering, is essential to the economical and efficient operation of any pipe system in which a loss of heat would require counterbalancing by an additional expenditure of fuel or energy.

Asbestos, diatomaceous earth, and magnesia are the insulating substances most commonly used, because of their heat resisting qualities, but cork, hair felt, and mineral wool are also poor conductors of heat. Shealy gives the accompanying table for the insulating value of several pipe coverings and also the loss of heat from uncovered pipe.

Pipe covering may be either "sectional," that is, molded to the shape of the pipe and attached by means of bands; or "plastic," which is mixed in the form of mortar, and placed on the pipe in layers. Covering for boiler drums, feed water heaters, breechings, and other large surfaces, is usually applied in the form of slabs or blocks, and wired in place. Sectional covering is usually made about 1⅜ in. thick and in 3-ft. lengths.

INSULATING VALUE OF PIPE COVERING

Kind of Covering	Thickness of covering, in.	B.t.u. lost per sq. ft. of pipe surface per hour per deg. diff. in temp.	Per cent of heat lost
Bare pipe.....	....	2.7	100.0
Mineral wool.....	1.30	.285	10.6
Hair felt.....	.96	.387	14.3
Solid cork.....	1.68	.438	12.9
Magnesia.....	1.25	.384	14.2
Asbestos sponge felted	1.24	.532	19.7
Asbestos air cell.....	1.26	.486	18.0
Asbestos fire felt....	1.30	.502	18.6

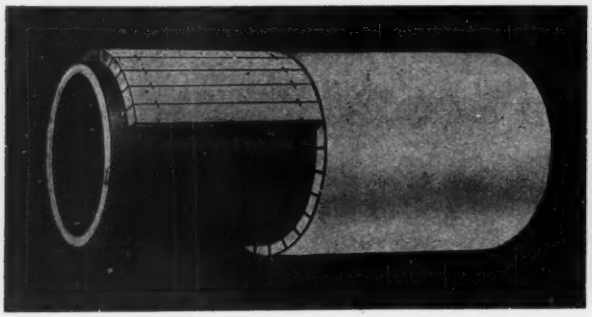


FIG. 1. CAREY'S MAGNESIA SECTIONAL BLOCKS

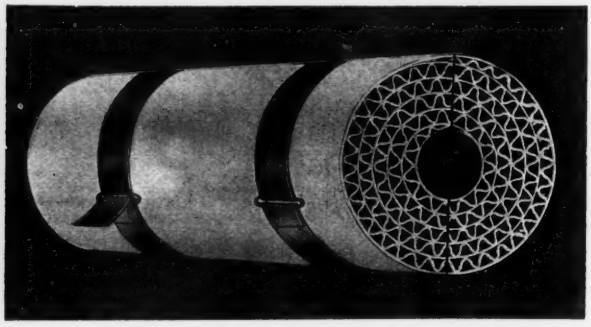


FIG. 2. CAREY'S AIR CELL PIPE COVERING

Sectional or molded covering has more joints but is more convenient for work subject to future alterations. Plastic covering obviates joints, adheres closely to the pipe, if of proper quality and workmanship, and the thickness can be varied to suit. It is more difficult to apply than the molded covering, but more permanent when applied.

LOSS DUE TO UNCOVERED PIPE

IT HAS BEEN experimentally determined that each square foot of bare iron pipe surface will radiate about 3 B.t.u. per hr. for each degree F. difference between the temperatures of the steam and the outside air, the exact amount varying with the velocity and humidity of the air. If, in any particular case, the essential conditions are known, the heat loss can be estimated in terms of dollars and cents. It will be necessary to determine the square feet of exposed pipe surface; the temperature of the steam subtracted from the average temperature of the surrounding air, will give the temperature difference. Conditions of operation of the plant will approximately determine the number of hours which steam will be in the pipe line during a period of one year. These factors will give the total B.t.u.'s lost during the year, and this amount divided by 965.8 will give the number of pounds of steam from and at 212 deg. equivalent to this loss. The evaporation per pound coal and the cost of coal per ton (including cost of handling it and ashes) being known, the money value of the loss is easily derived.

Expressed in a formula:

Loss per year due to steam condensed =

$$\frac{3\,A\,(t - t_1)\,N \times C}{965.8 \times 2000\,E}$$

In which A = sq. ft. of pipe surface exposed; t = temperature F. of steam; t_1 = average temperature F. of surrounding air; N = number of hours per year steam is in the pipe line; E = evaporation from and at 212 deg. F. per pound of coal; C = cost of coal and handling, per ton of 2000 lb.

For long tons the constant 2000 should be changed to 2240.

In steam plants, all exposed radiating surfaces, all high-pressure steam flanges, valve bodies and fittings,

heaters and separators, should be covered with a non-conducting material whenever such covering will improve plant economy. It is suggested that all main steam lines, engine and boiler branches, should be covered with 2 in. of 85 per cent carbonate of magnesia or the equivalent. Other lines may be covered with 1 in. of the same material. In low-pressure steam and hot water lines, wool felt in combination with asbestos has been found to give satisfactory service. Other forms are constructed with layers of corrugated asbestos paper using the principle that still air is a poor conductor of heat. Canvas is ordinarily placed over the covering and the whole held in place by wrought-iron or brass bands.

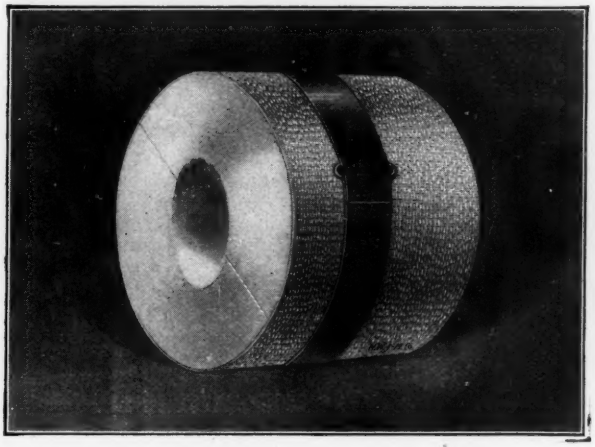


FIG. 3. J-M ASBESTOS SECTIONAL PIPE COVERING

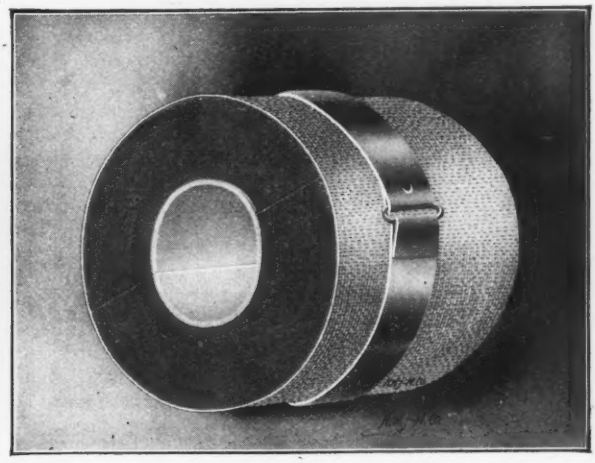


FIG. 4. J-M WOOL FELT SECTIONAL PIPE COVERING

Flanges and Valves

Although a system may be well covered as to pipe lengths, unprotected flange joints are frequently seen with no insulation whatever, in spite of the fact that one good sized flange joint with its bolt heads will furnish as much radiating surface as several feet of piping. It is, of course, more work to cover a joint than to cover a straight length of pipe, but covering the pipe and overlooking the joints is a penny wise and pound foolish policy, and with the many makes of special joint covering now available, there is little excuse for such neglect.

Even though the covering be made of plastic material, the saving by covering the joints is worth while, not only because of the reduction in condensation but also because condensation at these joints takes place at the worst possible location. Water can here get at corners and crannies where it may settle and corrode the metal, and in case of a flange joint it may here do its most insidious work in breaking down the system by seeping up around the packing and preparing things for a possible blowout.

The same argument applies to valves and other apparatus in the line, with the additional point that a valve for its own sake, regardless of the condensation effect in the system, should be protected as much as possible against rapid expansion and contraction.

FIG. 5. "DIAMOND N" ASBESTOS MAGNESIA SECTIONAL COVERINGS FOR JOINTS AND CORNERS

FIG. 6. "DIAMOND N" COVERING WITH ASBESTOS-MAGNESIA INNER LINING AND WOOL JACKET

FIG. 7. "NONPAREIL" HIGH-PRESSURE COVERING ON UNDERGROUND HEATING LINE

Covering for hot water piping follows very closely the requirements for steam piping. As the temperatures are lower, however, the insulation need not be as thick. All hot water piping should be covered wherever possible, for the B.t.u.'s are just as willing to sneak out of one place as another, and the presence of any bare spot offers them the opportunity.

Insulation for Cold Pipes

Heat insulation is an extremely important factor in refrigeration, where low temperatures are maintained

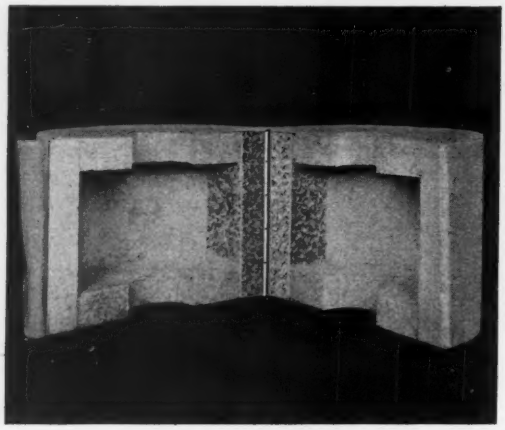


FIG. 8. "NONPAREIL" HINGED REMOVABLE FLANGE COVER

by the expenditure of additional energy to lower the temperature, which is a direct loss.

In view of the attention that is given to the efficient insulation of cold storage rooms and ice freezing tanks, it is rather strange that, in many instances, little or no protection is afforded the refrigerating medium while

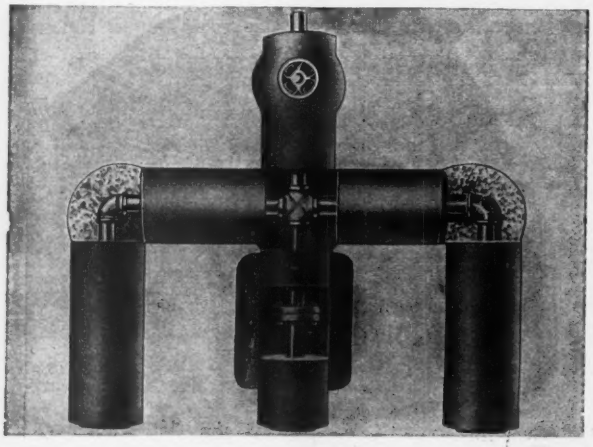


FIG. 9. CAREY CORK COVERING FOR BRINE AND AMMONIA PIPES

passing from the machine to the room or tank where its energy is to be utilized. This neglect is probably due to a general misconception of the amount of waste that is caused by uninsulated brine and ammonia lines. Authentic tests have established the fact that 200 ft. of 1½-in. uncovered brine pipe carrying brine at 15 deg. F. with the air at 90 deg. F., causes an annual loss of $206, with refrigeration at 50 cents a ton.

It is important that the insulating substance should not be readily injured by moisture. Hair felt was largely used in former years; this was wrapped around

FIG. 10. BRINE LINE AND PUMPS INSULATED WITH "NONPAREIL" CORK

the pipe and then covered with paper; then more felt and more paper, and so on for several layers; then the whole was given a canvas covering and several coats

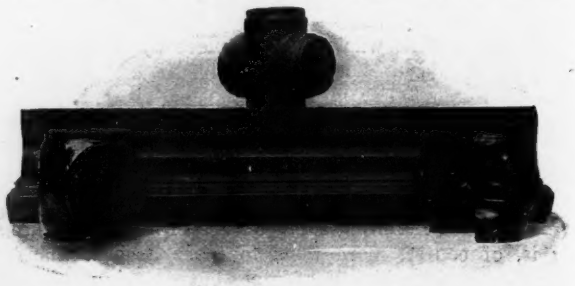


FIG. 11. "NONPAREIL" CORK COVERING

of water-proof paint were applied. Such insulation is found to be comparatively efficient and will last several years, but eventually the air will work through the hair felt, and the pipes will begin to sweat.

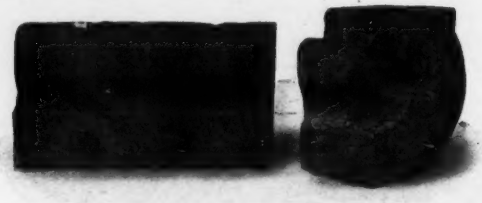


FIG. 12. CORK COVERING AFTER 11 YEARS' SERVICE IN A PHILADELPHIA HOTEL

A better insulation is made by soaking the hair felt in boiling resin, and applying to the pipe while the resin is still hot, and the sheets of felt are easily molded

to the shape of the pipe. These sheets are fastened with heavy twine; 2 layers of the covering are applied, and after the resin has cooled and set, the string is removed.

Granulated cork molded in a shape similar to the magnesia sectional steam-pipe covering is one of the standard forms of sectional insulation now on the market. In some instances, 2 layers of this are applied so as to break joints, and the whole covering is given a coat of rubber cement, making it virtually air-tight.

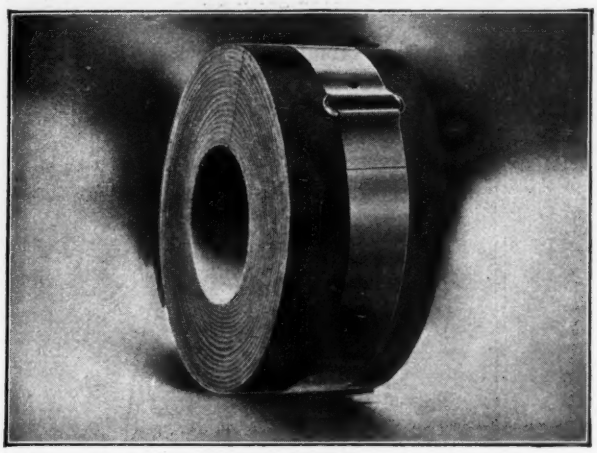


FIG. 13. J-M SECTIONAL COVERING FOR BRINE AND AMMONIA PIPES

Large brine mains that are boxed or laid underground can be insulated with a mixture of ground cork and pitch. The pitch is first melted, then cork is mixed with it, and the mixture is then poured over the pipes and well tamped around them.

The proper care of insulation covering plays a large part in its effectiveness. If, from any cause, it becomes loose or wet or disconnected, its efficiency is directly affected. It should be thoroughly inspected and repaired every year; the slight cost for this attention will easily be covered by the saving resulting from a greater efficiency.

Oil Fuel.-III

HEATERS. BY ERNEST H. PEABODY

VISCOUS oils, particularly when used with mechanical atomizers, have widened the field and increased the importance of oil heaters. Where formerly a single small heater, operated with the exhaust steam from the oil service pumps, was found adequate for the lighter oils and steam or air atomizers, it is now necessary, in order to use, or be prepared to use, the heavy oils on the market with mechanical spray burners, to install heating coils around the pump suction in the storage tanks, and to have in or near the fireroom, heaters using live steam and sufficient in capacity to heat the oil to perhaps 270 or 280 deg. F. (132.2 or 137.7 deg. C.). With mechanical atomizing burners, the heater is quite as important as the pump, as with viscous oil the plant is inoperative without it. Duplicate heaters are therefore necessary, one for regular operation and one for spare; or for large plants, what is perhaps better "commercial engineering" and quite as effective, it is quite common to install 3 heaters, 2 being used together in regular operation, and one spare.

The film heater invented by L. D. Lovekin and manufactured by the Schutte & Koerting Co., is a most ingenious design, and tests have shown it to be the most effective heater yet devised. The oil is forced in a thin film between 2 steam-heated surfaces of such shape that the oil is continually being mixed.

ATOMIZERS

THE successful mechanical atomizer, as we know it today, depends on the principle of giving to the oil a rapid whirling motion in a chamber in the tip and liberating it suddenly from a small orifice concentric with the axis of rotation. The centrifugal force engendered sprays the oil in the form of a hollow cone, the minute particles of oil flying off radially. The spray itself has no rotating movement unless this is brought about by a whirling body of air admitted around the burner tip.

Nothing that I know of can exceed the effectiveness

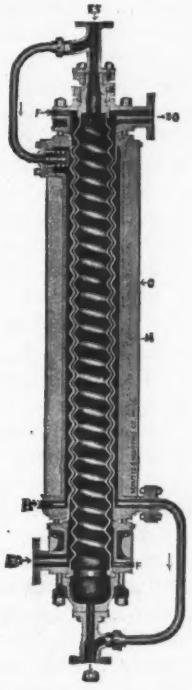


FIG. 6. SCHUTTE & KOERTING FILM OIL HEATER

of the steam atomizing oil burner. I have many times looked into a boiler furnace operating with this type of burner and been able to see every brick and joint of fire clay all glowing with incandescence, not a vestige of flame being present. Such a condition of flameless combustion may be obtained with air as an atomizing medium, but cannot, so far as I know, be obtained with mechanical atomizers. Owing to the high expenditure of steam, it does not pay to operate regularly under these conditions, but I am speaking of the effectiveness of the various types as sprayers.

But in economy of fuel, also, for steam production the steam atomizer is second to none. A widely circulated statement, by a high authority on oil burning, makes it appear that there is a difference in economy

of fuel between the steam and the air atomizer of 12 per cent in favor of the latter—though it is claimed that this is reduced to 4 per cent by deducting the cost of compressing the air. I find it hard to accept this first statement as a fact. In experiments with stationary boilers of the Babcock & Wilcox design, I repeatedly obtained boiler efficiencies exceeding 82 per cent, with steam consumption by the burners less than 2½ per cent of the output of the boiler, giving, after deducting the steam used by the burners, nearly 80½ per cent net efficiency. D. S. Jacobus obtained nearly 81½ per cent net efficiency with steam atomizers at Redondo in 1908. I question if it is possible to exceed these figures one iota by the use of air atomizers. There is certainly no such gain as 12 per cent, or even 4 per cent.

In speaking of air atomizers, it should be noted that there is little or no difference between the types using air at 30 lb. and over, and steam atomizers; in fact, the 2 styles are practically identical. The low-pressure air burners (air at a few ounces) are of different design and in a class by themselves. A representative burner of this kind is that known as the Lassoe-Lovekin Burner, and it was installed on many of the earlier ships, with much success.

Steam atomizers of every conceivable design have been evolved. The round-flame type is best adapted to the Scotch boiler furnace, though on account of its usual superiority in economy of steam used for atomizing, the flat-flame type is often installed with Scotch boilers. Vice versa, round-flame steam atomizers may be used in water-tube boiler furnaces, but here the flat-flame burner is of undisputed superiority. A good burner of this type, properly operated, should not use over 0.35 lb. of steam per pound of oil atomized.

Steam atomizers (in fact all burners) were classified by Frank Van Vleck, Technical Secretary of the Liquid Fuel Board, and his work has been extensively quoted by writers on oil burning. As far as I know, the classification is not used in the "trade," and about all the distinction which is necessary in addition to "round and flat flame" mentioned above, is "outside mixer" and "inside mixer"; that is, in one, the steam (or air) and oil come together outside the burner tip, and in the other, they are "mixed" inside the tip. There is little to choose between the 2 types, although the proportion of steam and oil, and the oil output, in the outside mixer is slightly affected by variation of the steam pressure—while on the other hand, any variation in the steam pressure in the inside mixer alters the rate at which the oil is delivered, as well as the proportions of steam and oil. But the main consideration in any burner is simplicity of design and ease with which it may be cleaned and repaired. Furthermore, the "atomization" of the oil in any burner, mechanical or otherwise, takes place at the orifice or outside of it, and such things as "mixing" and "atomizing chambers" in the inner workings of the burner are mainly "talking points" for the salesman.

THE ITALIAN AGENT of an American manufacturer desires information on sets of small motors and air compressors, light enough to be transported on muleback. Full information can be had from the Bureau of Foreign and Domestic Commerce, Washington, D. C.

Climbing a Stack

A 125-FT. iron chimney was unprovided with a chain fall or ladder. I was confronted with the problem of sending a man up to attach a block and fall to the top of this chimney, in order to give it a coat of paint. After some ineffectual efforts to get a string over the top by attaching the end to some toy balloons and allowing them to rise up the inside, we posted a notice offering a reward to anyone who would get a block hooked over the top of the stack.

This produced a volunteer where least expected, in the person of "Shorty," whose duties lay in wheeling out ashes—when sufficiently sober.

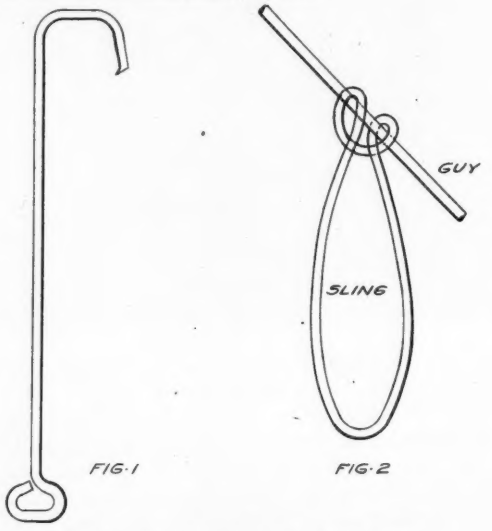


FIG. 1. SLICE BAR MADE INTO A HOOK
FIG. 2. SLING USED AS SUPPORT WHILE RESTING

"Shorty" proceeded to heat the end of a slicing bar in the fire, bending it into a hook as shown, Fig. 1.

He then provided himself with a ball of twine, and a length of sash cord, with which he made a sling as in Fig. 2. Pocketing these and spitting on his hands, he was soon well on his way up one of the stack guys, climbing, hand over hand and holding on with nails, teeth and eyelashes. When tired, he used the sling to sit in while resting, hitching it around the guy in the manner indicated.

Upon reaching a point 12 ft. from the top of the stack, where the guy was fastened to it, he lowered the twine, to which we tied the deformed slicing bar. Pulling this up, he hooked it over the top of the stack and squirmed up it forthwith. Again lowering the cord, he was provided with the necessary tackle to complete the rig.

It developed that "Shorty" had been a sailor in his youth, and had learned to climb ropes and drink rum at the same time.

He got his reward and the ashes remained stationary for a week. H. K. SCHOLEFELD.

A COMMERCIAL agent of the Bureau of Foreign and Domestic Commerce reports that an engineering firm in China is in the market, at intervals, for mining, metallurgical and power equipment.

Construction of Combustion Instruments

DIRECTIONS FOR MAKING GAS ANALYZER AND DRAFT GAGE. BY R. L. MOSSMAN

IN the accompanying drawing is shown a compact and portable flue gas analyzer for CO_2, which can be made by any engineer.

Referring to the drawing, B, B^1 is the burette, P the pipette, and K the leveling bottle. To construct the burette, get a wide mouthed bottle, B, of the dimensions shown.

Cut the bottom off with a gage glass cutter, and into the bottom insert a rubber cork, M, containing 2 holes to receive the glass tubes, G and R, which should be ⅛ in. in diameter or less. Cut the bottom of the cork as shown by the dotted lines to prevent the gas from being trapped in the bottle.

For the tube B^1, use a piece of gage glass ⅜ in. inside diameter and 7 or 7½ in. long. Insert the tube into the rubber cork in the neck of the bottle. In the

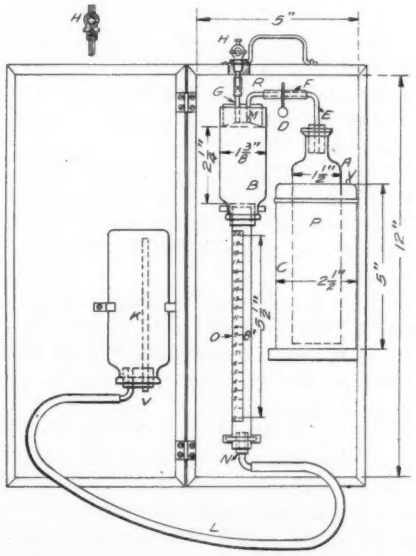


FIG. 1. FLUE-GAS ANALYZER FOR CO_2

lower end of the tube insert a cork, N, into which is a bent glass tube which is connected with a piece of rubber tubing, L, about 2 ft. long to the leveling bottle, K, which should have a capacity of about 50 per cent more than the burette. It is made from a wide-mouthed bottle as shown, the vent tube, V, should extend the full length of the bottle, to allow air to escape or enter as the water rises or lowers in the bottle. When not in use, the leveling bottle is held in the lid of the case by spring clips as shown. The pipette, P, is constructed from a 4-oz. sample oil bottle of 1½-in. outside diameter. Cut the bottom off and insert a rubber cork in the neck, into which insert the glass tube, E, bent as shown. The bottle, A, is set inside of the can, C, of the dimensions shown, by cutting a hole in the cover of the can, the size of the bottle, this cover being provided with a vent, V.

The 3-way cock, H, consists of a ⅛-in. pet cock drilled as shown in the section. Solder a short piece of brass tubing into the pet cock and connect this to the glass tube, G, with a piece of rubber tubing. A burette of the dimensions shown will contain about 50 c.c. The capacity of the tube B^1, from 0 to 20 on the scale, must be 20 per cent of the bottle, B, and tube.

The burette is calibrated as follows. Paste a strip of paper, O, on the tube, B^1. Lay off the points 0 and 20, 5½ in. apart. Support the burette in a vertical position, put a piece of rubber tubing on the tube, R. Close the lower tube, L, with a pinch cock and pour water into cock H, until the level comes up to 20 on the scale. Open the pinch cock on the tube, L, and draw off the water into a measure until the surface of the water is at 0 on the scale. This amount of water will be 20 per cent of the total volume of the burette.

To this add 4 times its volume. Pour this water into the cock, H, adjust the cork, M, in the top of the burette until the water shows in the tube, G, about ¼ in. above cork M. Close the rubber tubing on tube R with a pinch cock, D. Force the cork, M, down until the water shows in the side outlet of the cock, H, with the cock turned to a position opposite to that shown in the cut. Seal the cork, M, with wax.

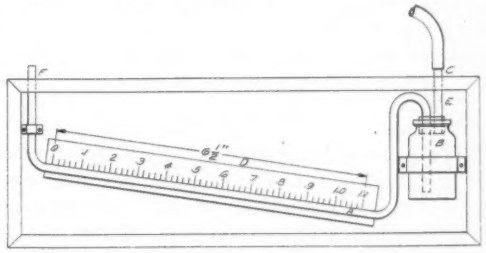


FIG. 2. EASILY MADE DRAFT GAGE

Divide the scale into 20 equal parts, each of which will represent 1 per cent. Divide the 20 spaces into 5 equal parts, which will give a reading of 0.2 of 1 per cent. Put some steel wool or pieces of glass tubing into the pipette bottle, P, to increase the absorption surface.

Dissolve 2 oz. of caustic potash in 9 oz. of water. Remove cork from pipette bottle, P, and fill the bottle and can, C, about ½ full of this solution, fasten pipette and burette into the case and connect as shown. Fill the leveling bottle, K, with water, open cock H, and raise the leveling bottle, K, until water shows at cock H. Close cock H, and remove the pinch cock, B, lower bottle K until the caustic solution is drawn up into tube E ½ in. above the cork, being careful not to draw any of the solution over into the burette. If any of the solution should be drawn over, wash out the burette, and fill with fresh water. Also note that the solution is not drawn low enough in can C to allow air to enter bottle P. If it is too low, pour more into can C.

The instrument is now ready for use. To take a sample of flue gas, insert a small tube or piece of ⅛-in. pipe into the path of the gas on the boiler side of the damper. Connect this tube to the cock, H, with a piece of rubber tubing; hang the instrument on the

boiler setting, lower leveling bottle K, and open cock H. The water in the burette will flow into the bottle and draw the gas into the burette.

Turn cock H so that the side outlet is in communication with the burette, and raise the bottle, expelling the charge to the atmosphere. Repeat this 2 or 3 times to draw all the air from the tubing and pipe. When drawing in the final charge, lower the bottle, K, until the water in the bottle is level with the 0 mark on the scale, draw the gas to this mark, and close the cock, H. The burette will now be full of gas at the pressure of the atmosphere. Open pinch cock D, and raise the leveling bottle, forcing the gas into pipette bottle P until the water shows in glass tube R just above cork M. Allow the gas to remain in the pipette about one minute. Lower the leveling bottle, drawing the gas back into the burette until the caustic solution in the pipette rises about ½ in. in glass tube E, then replace pinch cock D on tube F. Bring the leveling bottle close to the scale on the burette, holding the bottle so that the level of the water will correspond to the level in the burette. The height that the water reaches on the scale will show the per cent of carbon dioxide or CO_2 that was absorbed by the caustic solution.

This will be the per cent in the flue gas. This percentage should be about 12 for good average firing. If it is much lower than this, look for leaks in the boiler setting, thin fires, or excessive draft for the load that the boiler is carrying. It is well to install a draft gage on the boiler front, and connect it to the furnace, and note the reading of this gage when the percentage of CO_2 is the highest, carrying the fires and draft to suit.

Draft Gage

To construct a simple and accurate draft gage, obtain a small wide-mouthed bottle, B. Perforate the cork for 2 glass tubes about ⅛ in. in diameter. Bend tube A, as shown, making the slope of the tube on the scale about ⅞ in. to 6 in. in length. The tube can be bent by heating in a blow torch. Mount the tubes and bottle in a box of the proper size. Put enough red draft gage oil into the bottle to cover the lower end of tube A. Connect a piece of rubber tubing to tube E, and blow into the tube until the oil is forced over into the long leg of tube A. Add enough oil to bring the oil in the tube to the 0 mark on the scale, D.

Mount the gage level and connect the instrument into a pipe with a common U gage, in which water is used. Draw on the U gage until it shows a draft of 1 in. of water, and mark the point on the scale where the oil drops in tube A. This will equal a draft of 1 in. Divide this distance into 10 equal parts from the 0 mark. Each one of these will represent 0.1 in. draft. These can be divided into 5 equal parts, which will give a reading of 0.02 in.

This gage can be mounted on the boiler setting, and connected by tube C and a piece of pipe to the furnace and will give the draft over the fire.

A man from Argentina, who is now in the United States, writes the Bureau of Commerce that he wishes to represent American manufacturers in Argentina, Uruguay, or Chile. No particular line is specified, but he has previously handled leather goods, hardware, etc. References are given.

Feed Water Heating

Convenient Charts and Operating Data on Open Heaters. By John D. Morgan

In the hands of a capable engineer the metering open feed water heater becomes a very valuable piece of power station apparatus. The first problem to be worked out with an open heater is what temperature of feed water should be obtained with varying amounts of exhaust steam. The formula that is generally used for this calculation is

$$T2 = \frac{T1 + 0.9S\,(H + 32)}{1 + 0.9S}$$ in which

H is the total heat of exhaust steam at the observed pressure, T1 is temperature of water fed to heater, T2 is temperature of water leaving the heater, S is ratio of exhaust steam to water fed to heater (by weight). Efficiency of heater equals 0.9 (that is radiation and other losses equal 10 per cent), 0.9S (H — T2) equals B.t.u. given up by each pound of exhaust steam, T2 — T1 equals B.t.u. absorbed by each pound of water.

In the curves, Fig. 1, the final feed water temperature that will be obtained with varying per cent of exhaust steam available for heating feed water and a varying initial temperature of water fed to heater may be obtained.

By the proper arrangement of the exhaust steam piping it will be found that the steam consumption of any auxiliary or set of auxiliaries can be computed from the temperature rise and the amount of water heated in the open heater.

The formula given below is a basic formula for the calculation of the amount of exhaust steam or the amount of water fed to the heater. This formula can be expressed in various ways, but the 2 most useful ways are those given below.

$$Ws\ (H - T2) = Ww\ (T2 - T1) \quad (1)$$

$$(Wt - Ww)\ (H - T2) = Ww\ (T2 - T1) \quad (2)$$

in which T2 is temperature of water leaving heater, T1 is temperature of water supplied to heater, Wt is total weight of water and steam, Ww is total weight of water fed to heater, Ws is total weight of steam fed to heater, H is total heat of exhaust steam at observed pressure.

Curves in Fig. 2 show the amounts of exhaust steam needed to heat the feed water to a temperature of 212 deg.

In regard to the daily operation of the heater: First of all, it is necessary that the heater supply feed water of the highest temperature obtainable. To determine if this is being done, a test should be made to determine the working points of the heater for a period of 24 hr. The following readings should be taken at least every 6 min., and plotted on curve sheets for comparison:

Height of water carried in heater.
Temperature of water entering heater.
Temperature of water leaving heater.
Temperature and pressure of exhaust steam.
Amount of water heated (calculated hourly).
Amount of exhaust steam (calculated hourly).

If an examination of the test results reveals the fact that the heater is not delivering the water at the highest temperature possible, an investigation should be started to determine the cause.

The first point to examine would be to see that a constant water level is being maintained in the heater. If the water level is varying and causing the heater to overflow, a water seal can be placed on the overflow line (that is, a U section of pipe about 7 ft. in height); this will stop the water from flowing over, by the simple means of putting a back pressure on the overflow line. This back pressure is not sufficient to cause any damage to the heater. It will be found that in a great many heaters the float which controls the flow of water to the heater is located near to the suction pipe to the feed water pumps, which results in the float receiving and transmitting a false reading to the control valve, and water is not admitted at the proper time. The heater should now be given a thorough cleaning. The pan surface in most heaters is designed for clear water, and when mud and other foreign matter accumulates on the pans, the surface is cut down and results in the water not being properly heated. Next, the drip and trap discharge connections should be looked at. The proper place for these to discharge is the open heater, but they must be connected in such a manner as not to interfere with the flow of water to the heater; in other words, they should discharge into the steam space of the heater.

Suppose that at times it is found that there is too little or too much exhaust steam in the heater; if this occurs for any period of time, it will be found advisable to install a constant pressure or heat balance valve on one of the main units. This valve can be set to maintain a constant pressure in the exhaust steam main by bleeding low-pressure steam from or to the secondary stages of the main unit.

In general, it will be found that if close attention is paid to the open heater, the evaporation of the plant can be increased and the coal rate reduced.

Preparedness Program for U. S.

PUBLIC opinion has gone forward with giant strides since the outbreak of the European war. The army and navy appropriation bills in Congress go far beyond anything ever before considered in time of peace. The navy building program of the Senate includes 8 capital ships for the first year, in a scheme covering a period of 3 yr. The army reorganization law has already provided for a regular force in excess of 200,000 men, and the army appropriation bill reported by the Senate Committee on Military Affairs provides for a Council of National Defense. A further provision authorizes direct purchases from private firms analogous to the system of prearrangement for war supplies approved in the referendum ballot.

However, there is no bill before either the Senate or the House which provides for a national system of universal military training. Yet public opinion is swinging strongly to a final conclusion on this vital subject. And now has come overwhelming testimony from that section of opinion which is not only most conservative but which is also most closely concerned with the actual cost and with the economic problems which go with any system of universal military training. The ballot of the commercial and trade organizations of the Chamber of Commerce of the United States, the leading business associations of the country, shows 889 votes in favor and only 56 against a system of universal training which shall be enforced by law to furnish men for defense in war as well as in peace. Forty-three States were represented. A responsible and intelligent element of the citizens in 24 of these States voted unanimously. In 18 others the vote ranged from more than 100 to 1 to 2 to 1. In only one State was the vote opposed.

The actual wording of the question as finally drafted in the ballot was:

"The committee, recognizing military obligation equally with the civic obligations as a fundamental duty of democratic citizenship in a republic, and to establish a system which will affect every man alike—recommends that universal military training be adopted as a fundamental democratic principle of our military policy and be enforced by law to furnish adequate land, sea and industrial forces in peace and war."

The main point is that business men have now recognized the military obligation in a democracy as of equal rank with the civic duties of citizens and stated their conviction that recognition of this principle is fundamental. They have gone further, and recorded a conclusive vote that a system of universal military training is one which will affect every man alike. In other words, instead of being militaristic or aristocratic, it is a thoroughly democratic principle.

Finally, business men are not afraid of compulsory military education. They believe it will develop a better-balanced and more self-disciplined youth from which to build succeeding generations of American citizens. They have registered their opinion that it will not only prepare citizens for wars which all hope to avoid, but will fit them better for virile, substantial peace which all hope to enjoy. They do not fear the obligation of military training any more than that of taxes or of education. Few believe that if the collection of taxes were left to the compulsion of the spirit of America very much revenue would accrue. There is no less reason to believe in obligatory taxes than in obligatory defense. The beginning of compulsory education was regarded by a famous English philosopher, Herbert Spencer, as the doom of progress; it has proved to be one of its mainstays. The acceptance by the American people of an equal obligation for military duty on the part of all citizens should, it is believed, prove of equal value. It is now urged emphatically by a responsible and conservative element of the public and in this movement the Chamber of Commerce of the United States will, therefore, be led, necessarily, to play a large part.—The Nation's Business.

THE BUREAU OF STANDARDS, Department of Commerce, in connection with a general study of fire-resisting materials, is considering among other phases of the subject the development of a fire-resisting material for use in constructing, in whole or in part, the deck structures of excursion and passenger steamers. So far as may be applicable, the material when developed would also be considered in relation with other marine uses.

The Bureau of Standards would be glad to receive from manufacturers samples of such materials as they consider suitable for the purpose, in order that they may be given consideration.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

Automatically Controlled Feeder Voltage Regulators

REFINEMENTS IN DESIGN DETAILS RESULTING IN IMPROVED EFFICIENCY, SIMPLIFICATION OF AUTOMATIC CONTROL AND INCREASED RELIABILITY. BY E. E. LEHR AND I. C. MINICK

BECAUSE of the increasing importance of the feeder regulator, a considerable amount of engineering investigation and experimental work has been carried out with a view to the further improvement of the induction-type regulator from the operating standpoint. Following the tendency in other lines of power apparatus, steel has been substituted for cast iron where practicable. Single-phase units of the more commonly used sizes are now built with the so-called frameless type construction which is largely used for induction motors. With this type of construction, the cross-section of the magnetic circuit is increased without increasing either the size of other parts or the floor space, but the iron loss and exciting current are correspondingly reduced.

FIG. 1. INDUCTION TYPE FEEDER-VOLTAGE REGULATOR WITH TANK REMOVED

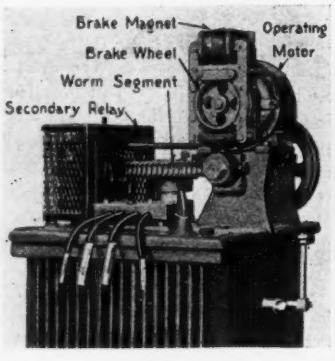


FIG. 2. AUTOMATICALLY CONTROLLED REGULATOR MOUNTED IN SHEET-STEEL CAST-IN TANK

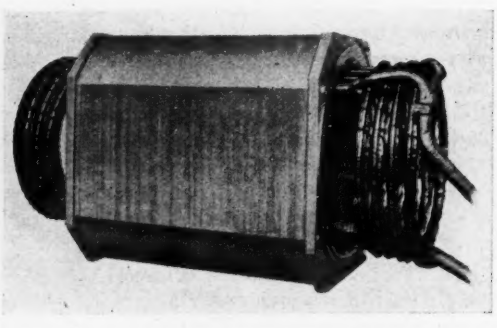


FIG. 3. LAMINATED STEEL STATOR CORE AND WINDAGE

A regulator of recent design is shown in Fig. 1, removed from the tank in which it is immersed in transformer oil for operation, and the regulator mounted in a sheet-steel cast-in tank is shown in Fig. 2. This regulator has a laminated steel stator core assembled and rigidly clamped between steel end plates by heavy steel rods passing longitudinally through the core at the corners of the punchings. This forms a compact unit, of a convenient shape for winding. Figure 3 shows the core after the stator windings are in place.

The primary core or rotor is likewise built of steel punchings, these being assembled on a cast-iron spider and clamped between finger plates, as shown in Fig. 4. This spider is pressed on a heavy steel shaft having ground bearing surfaces. For small regulators the punchings are built up directly on the shaft. The copper loss in the short-circuit windings of single-phase regulators of the type shown has also received attention. Instead of using one or a few turns of a solid or bare stranded conductor, many turns of small-sized enamel wire are used and a material reduction in the loss is effected.

Open slots are used in both the rotor and stator punchings except for the short-circuit windings of single-phase regulators. Here no advantage is gained by the use of form-wound insulated coils, and partially closed slots are therefore used to reduce the magnetizing current as much as possible. The form-wound coils are held in position by hard fiber wedges in small grooves at the top of the slots, as shown in Fig. 4.

To prevent vibrations which would otherwise occur in single-phase regulators because of the magnetic action between the rotor and stator cores, special methods of

machining the end frames and bearings are employed to secure perfect alinement of the bearings and accurate centering of the rotor shaft. The stator punchings with end plates are carefully built up on an expanding mandrel and riveted together. Before removing the mandrel the stator is placed in a lathe and finishing cuts are taken on the bearing surface between the stator and brackets, thus insuring the best possible alinement and a uniform air-gap. Also a heavy rotor shaft with long bearing surfaces is used to secure rigidity. These features of design have successfully overcome vibration, and the modern regulator operates quietly and presents no difficulties due to vibration.

Regulators operate in most cases under severe conditions as regards both voltage and mechanical strain on the insulation of the coils. Unlike most other types of power apparatus, the regulator carries the entire load on the feeder through its secondary winding and frequently has no protection other than an oil circuit-breaker. It is, therefore, subject to voltage strains from surges, static or other line disturbances, and in addition the secondary coils receive the mechanical shocks resulting from heavy current rushes due to short-circuits occurring on the line. If the regulator is installed in or

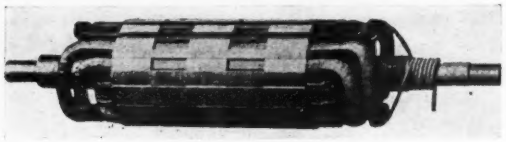


FIG. 4. PRIMARY CORE OR ROTOR

near the generating station, the rush of current through the secondary coils during a short-circuit may reach an excessive value and result in violent mechanical forces in the windings, tending to distort the coils and badly injure the insulation.

Because of the severe service conditions the coils of feeder regulators are form-wound and very carefully insulated, especial care being taken to secure sufficient mechanical strength to resist bending or twisting under strain. The tendency of a heavy surge of current passing through the stator winding is to bend the ends of the coils extending beyond the core slots backward away from the rotor. Such bending would result in cracking the impregnated insulating materials and probably lead to a failure of the insulation of the coils to the iron core or shortcircuit a number of the turns to the boil. To strengthen the coils against distortion from current rushes, a recent improvement is to use bracing rings formed from steel rod of circular cross-section thoroughly insulated, which are securely bound over the ends of the coils, as shown in Fig. 3. These rings add a high degree of stiffness to the coils and, therefore, increase the factor of safety of the regulator against failure in operation. The installation of preventive reactances connected in series with the feeder wires on the load side of the regulator will also prove a valuable safeguard on many circuits. When a short-circuit occurs near the station on a feeder connected to the bus-bar of a large generating plant, the instantaneous current which may flow is so large, and the resulting magnetic stresses in the windings are so great, that it is not practical to provide sufficient protection within the regulator to take care of these enormous stresses. For such conditions separate current limiting reactances should be provided. These are desirable not only to protect the regulator, but also to protect the feeder itself against extremely destructive short-circuits.

The latest regulators are automatically controlled by means of a voltage regulating primary relay and an electrically-operated motor switch commonly called an aux-

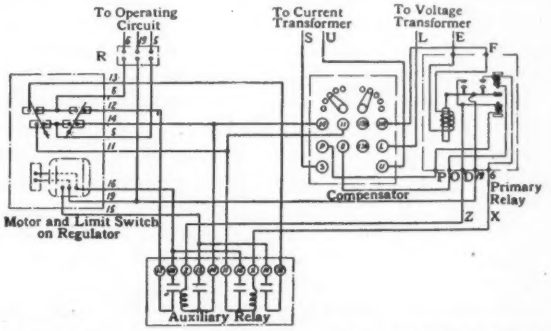


FIG. 5. CONTROL DIAGRAM OF AUTOMATICALLY-CONTROLLED REGULATOR WITH AUXILIARY RELAY MOUNTED SEPARATELY

iliary or secondary relay. A line drop compensator with the necessary current transformer, and a voltage transformer for reducing the line voltage to a value suitable for the primary relay, are the accessories normally required for automatic operation.

In order to simplify the control wiring, and thus lessen the chance for failure in the control circuit, a modification of the secondary relay has been recently

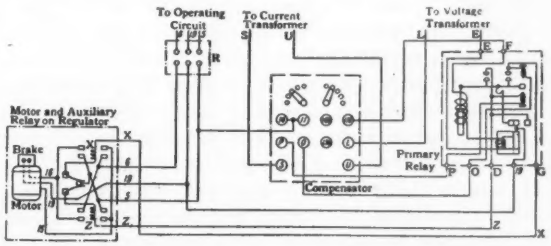


FIG. 6. CONTROL DIAGRAM OF AUTOMATICALLY-CONTROLLED REGULATOR WITH AUXILIARY RELAY MOUNTED WITH LIMIT SWITCH ON REGULATOR COVER

made whereby the limit switch used to stop the motor, in case of failure of one of the relays, and thus prevent overtravel of the regulator, is incorporated as a part of the relay, and the whole is mounted on the regulator top cover. Formerly the limit switch was mounted on the regulator cover and the auxiliary relay was mounted separately. It is possible, even with a separately mounted auxiliary relay, to use but 5 control wires to the regulator, but the motor would not have the protection against burnouts that is provided by the above connections. With separate relays and but 5 control wires, if the regulator is turned back so as to start to close the limit switch again after the limit switch trips, it is possible to stop the regulator with the limit switch in such a position that, when an attempt is made by means of the

relay to operate the regulator in one direction, single-phase current only will be connected to the motor, and as the motor will not start it may be burned out.

When the connections are as shown in Fig. 5, the limit switch is so constructed that the circuits from 5 to 14 and from 5 to 11 are always opened before the circuits from 6 to 12 or from 6 to 13 are opened. In closing, the reverse action takes place, that is, the circuits 5 to 14 or 5 to 11 close last. Since the operating coils of the auxiliary relay get their current through leads 14 or 11, the auxiliary relay cannot operate until the circuits are completed, so that single-phase current alone cannot be connected to the motor.

In Fig. 6 is shown the control diagram of the automatically-controlled regulator, shown in Figs. 1 and 2. Five control wires only are brought out from the relay, but the motor is protected from the possibility of having single-phase current connected to the motor (except as a result of a defective supply circuit or defective apparatus), since the motor is stopped by interrupting the current to the operating coil of the auxiliary relay. Regulators are frequently operated (especially when being installed) by pushing in the auxiliary relay contacts by hand. Since the opening of the circuit to the operating coil would not stop the motor in this case, it would be possible for the regulator to overtravel and jam the worm. To prevent this a device is arranged to open mechanically the auxiliary relay contacts if for any reason the auxiliary relay does not open when the circuit to the operating coil is opened.—The Electric Journal.

A Town with Fluctuating Lights

By N. G. Near

I NEVER before believed that any town, village or city would "put up" with a lighting system in which the lights constantly fluctuate violently in intensity or lighting power. In South Dakota is a small town of about 800 which is electric lighted. The dynamo in the power house is driven by a gasoline engine of the hit and miss type. No doubt, you know the rest.

I was in this town not long ago and stopped at a hotel. The lights fluctuated frightfully, and at regular intervals. I asked the hotel proprietor what the trouble was.

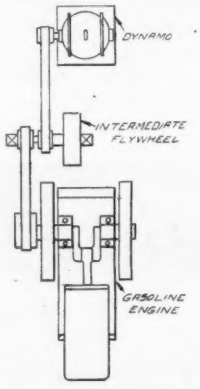
"I don't know," he answered. "The boys at the power house don't know what is the matter. They say everything is all right; but everybody who comes to this hotel complains about the lights, just like you."

The power station was not far from the hotel, for I could hear it from the window of my room. I could hear the chug chugging very distinctly. Every time the engine "chugged" the lamps increased in brilliancy all over the town.

The trouble could easily be remedied, though. I would have gone over to the power house and would have offered the engineer some advice; but I do not believe in "butting in" and offering free advice that might be unwelcome. I prefer to write about it here. If the engineer is wide awake, if he subscribes for a journal that treats of the troubles of power plants, he will read this and the trouble will be remedied. I fear, however, that he will not read it, for I am of the opinion that he is no student. Time and brain energy are required to read a technical journal properly in the same way that both of them and muscular energy are required to run a power plant properly.

The dynamo in the above-mentioned plant is belt driven. The belt slips—perhaps. In fact, it doesn't make much difference in this case whether the belt slips or not, for the lights would fluctuate anyway. The thing that is needed is more weight in the flywheel.

It is difficult to add weight in the literal sense, but practically it can be done in several ways. The present flywheel or flywheels could be removed and replaced by heavier ones, or 1 or 2 more flywheels could be added to the engine shaft. The engine shaft could be lengthened by means of a good coupling—either rigid or flexible, preferably the latter, and the necessary additional flywheel or flywheels could be placed on this shaft. The greater the total weight in the flywheels, the less will be the fluctuation, and by making the weight great



ARRANGEMENT WHEREBY FLUCTUATION OF ENGINE SPEED MAY BE REDUCED TO A MINIMUM

enough the fluctuation will become so slight that it will not be noticed by the human eye. Nearly all electric lamps fluctuate. The only ones that do not are those that are supplied with perfectly steady currents such as are produced by storage batteries and other batteries, and even they are not "perfect," for the voltage changes constantly, although but slightly.

Or, the above engineer could put a flywheel on the dynamo shaft, which would perhaps be the better solution, for a smaller flywheel could be used and belt slip would have little, if any, effect. By using heavy flywheels on the engine and one on the dynamo shaft also, he would be doubly protected against fluctuation.

The arrangement shown in the accompanying figure would be better than nothing at all. It would not cost much, would require less labor to install, and would be perfectly safe. The additional bearings and pulleys would decrease transmission efficiency a trifle; but if they were well alined and oiled this would amount to little. There might still be some belt slip between the engine and intermediate flywheel; but that, also, would have no effect on the lamp brilliancy. The belt between the intermediate flywheel and dynamo should not slip at all.

A good sensitive hit and miss governor used in connection with any of the above solutions will eliminate the trouble.

Compressed Air vs. Steam for Steam Hammers

AN INSTANCE WHERE COMPRESSED AIR IS MORE ECONOMICAL THAN STEAM. BY J. P. STONE

STEAM hammers, before the advent and general adoption of compressed air, were operated by steam, as this was the only source of power for moving them until recent years, and even now in some shops with compressed air used for the tools, steam hammers are operated by steam.

Until a few years ago the air compressors in general use were of the single-stage type, with a very high steam consumption, and, obviously, it would not be along the lines of increased economy to use a steam-driven air compressor to supply compressed air to operate the hammers when they could be operated direct from the steam supply; but when other sources of power are available, this no longer remains true, and at the present time there are many plants that operate hammers by compressed air with gratifying and economical results. But the newer source of power has not found the universal application that its ready adaptability to the multitudinous duties to which it is so easily applied would warrant; this, together with a natural reluctance to fall into making a possible move in the wrong direction, coupled with the idea that steam hammers were not suitable for operation by compressed air, has caused many to cling to steam for the hammers when remodeling power plants; and it is not at all uncommon to find cases where electricity is used for the motive power for everything except the smith shop, where a boiler is still used to operate the hammers, the cost of this being out of all proportion to the results accomplished. The continuation in the use of steam for the hammers when this fluid is not employed for motive power is usually a costly mistake, but the matter of determining the amount of air required to run the hammers requires considerable experience to deduce, and their intermittent working also renders it more difficult to ascertain, and make accurate comparisons of the relative costs of operation under the different systems.

It is the prevailing idea that it takes a great deal more steam to run an air compressor for the hammers than if they were operated by steam direct, and while this is undoubtedly the case, still no modern shop is complete without a compressed air plant for pneumatic tools, and in such cases it will often prove cheaper and more advantageous in various ways to have the compressors of suitable capacity to operate the hammers as well. An idea of the comparative cost of operating steam hammers by compressed air and by steam is difficult to arrive at unless some trials are made to determine the facts, and even then the results would not be applicable to every case, nor could general deductions be taken from them as every case would have to be considered separately owing to the variety of conditions that would influence the results.

Compressed air gives quicker operation than steam, the hammers strike harder blows and are more lively in every way, there is no condensation, nor dripping water, nor hot parts to burn and inconvenience the workmen. The hammers themselves require no readjustment further than to see that rings fit, and that leakage is, as far as possible, avoided; compressed air leaks are more important than steam leaks, but not being accompanied by hissing jets of steam, or dripping water, are often overlooked, particularly as they are not annoying they do not receive attention. A compressed air leak will not take up, and rapidly becomes worse; no leaks should ever be tolerated around a compressed air plant.

The use of reheaters is strongly to be recommended in connection with hammers, as by this means the air is heated before reaching the hammers, is expanded and does more work than if not heated; besides, the heating overcomes the low temperature and freezing that may accompany the expansion of the air in cold weather.

In planning an installation of this sort, only the best seamless steel piping and heavy fittings should be used, ample receiver capacity should be provided; in fact, it is scarcely possible to carry this too far, I might give an instance that will illustrate this effect. A large structural iron works originally had to run 2 air compressors of equal capacity to keep up the pressure, but when they increased the receiver capacity some 4 times one unit was found to be sufficient.

In shops having steel roof trusses the receivers can be hung from or supported on the trusses, where there is usually ample room for them; here they are out of the way, occupy no floor space, and drainage is greatly facilitated. Care should be taken to arrange the piping so that leaks will not be caused by the vibration when the hammers are working; this is easy to accomplish by making long sweep bends in the pipe, in preference to using fittings, and suitably anchoring it so that connection points are not subjected to operative stresses.

Some interesting trials were made in a large railway workshop, and while they did not give the actual costs in each case, some startling points were brought out, and valuable deductions can be made. The possibilities in the different ways of using a ton of coal is shown in the most striking and instructive manner. These shops were electrically driven, the power plant was equipped with bituminous gas producers and gas engines, a complete compressed air installation was provided, and it was intended to operate the steam hammers by air; but a steam boiler was also put in so that they could turn to steam should it for any reason prove unsatisfactory to drive them by air. They were run by steam for some time as the air piping had not been finished.

In the smith shop were 3 hammers, 20-cwt., 12-cwt., and 10-cwt., which were used to turn out the usual run of forgings attempted in railway works. Air reheaters were provided and large receivers were hung from the roof trusses; in fact, every precaution was taken to make their operation a success. There were in the power house 2 2-stage Ingersoll air compressors each having a free air capacity of 400 cu. ft. per min. at a speed of 170 r.p.m., driven by 80-hp. electric motors. After having operated the hammers by steam for a month the pneu-

matic plant was ready, no alteration whatever was made in the hammers, and aside from a notable improvement in their working, nothing unusual developed; one compressor was able to supply all the air required.

The only comparison that could be made is to show what could be accomplished by using a ton of coal under different conditions. One ton of steam coal per day burned under the boiler would supply steam for operating the hammers at a fuel cost of $10, the labor on the boiler cost $2 a day. Now an additional ton and a quarter of gas coal, also costing $10, would produce, if used in the gas producers, sufficient gas to run a 250-hp. gas engine for the same period. This engine would be able to operate 3 compressors of the size mentioned, or one compressor and leave 170 hp. available for other work. Of course, these comparisons would only apply to this plant or another of similar class, but it shows in a most striking manner that under certain conditions steam hammers can be operated by compressed air with vastly greater economy than by steam.

Steam Safety Valves*

BRIEF DESCRIPTION OF NEW DESIGN IN WHICH LOW LIFT IS MAINTAINED AT POPPING PRESSURE AND HIGH LIFT DURING EMERGENCIES.* BY G. H. CLARK

THE question of adjustment presents the real difficulty in safety valve design. Means for regulation should in general perform their functions with as little effect as is possible on the lift and, per unit of lift, should produce no effect on the discharge capacity. Other than lift, the 2 functions to be controlled by regulation of the variations in lifting force are warning and blowdown. A valve which chatters or vibrates at the instant of opening, or sizzles at that time, shows a lack of lifting force at low lifts, and one which shows an excessive blowdown demonstrates that the lifting force at low lifts is too great to allow of closure, and it follows that the requirements of warning and blowdown are somewhat combative. If it is possible, means should be provided for making, in so far as is possible, the

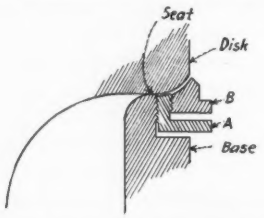


FIG. 1. SECTION OF SEAT AND DISC OF VALVE ADJUSTABLE FOR VARIABLE LIFTING FORCE

means adopted to regulate one independent of the other. Blowdown is an absolute necessity on the spring-loaded type, due to the existence of lifting force outside the spring chamber, and it is clear that attempts to reduce the blowdown will tend to decrease the lift and relieving capacity. In general, the real secret in the design of a perfect safety valve lies, not in the production of excessive lifting force, but in controlling and adjusting it; the action of a valve is dependent, not on the quantity of lifting force, but on variations of lifting force with discharge capacity and pressure.

DESIGN OF NEW VALVE

IN FIG. 1 is shown a valve which has means for adjustment based on the production of variable lifting force as stated above. The 2 annular rings shown at A and B carry on their upper surfaces curves which approximate in shape the curve of the disc. Inner ring A, which I choose to call the warning ring, is threaded upon the base of the valve just outside the flat seat and carries, threaded upon it, ring B, adapted to control the blowdown. These rings may be lowered away from the disc, or given what I choose to call initial clearance.

It is clear that if both of these rings are lowered, an extreme distance, when the valve tends to open no lifting force will be available. If ring A is raised to a position near the valve disc, a lifting force will be provided which will depend, first, on the pressure produced between it and the disc, and second, on the extent of the disc area on which this pressure acts. The pressure depends on the area of the passage and the area in the valve is a function of the initial clearance and the shape of the curve. These factors are built into the valve to produce the desired result, which is to provide lifting force at small lifts to overcome excessive warning, and it has been found that with the proper shape of ring, on its initial clearance, depends the warning of the valve. Since this warning ring alone produces only small lifts, it has no appreciable effect on the blowdown.

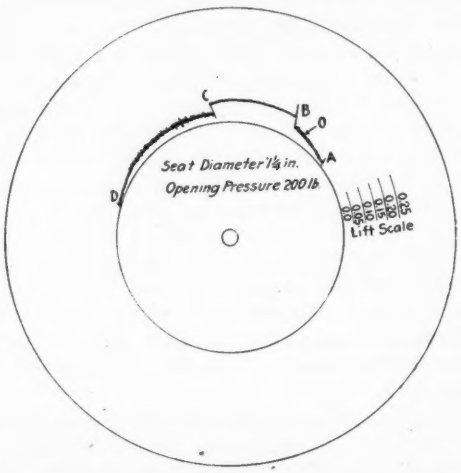


FIG. 2. DIAGRAM OF OPERATION OF A "SECOND OPENING" VALVE

As blowdown ring B is raised from its lowest position, there is a tendency to build up pressure between it and the disc when the valve is open, which tendency

*Excerpts from a paper presented before the A. S. M. E.

increases as the disc is approached. If a reasonably large clearance is left, it is clear that this ring produces almost no lifting force at low lift, since the area of the passage along this ring is large in comparison to that over the seat, and it follows, also, that as the disc lifts the effect of this initial clearance on the area of the passage becomes less and less as lifting continues.

The ideal safety valve for practical purposes is, I believe, one in which a reasonably low lift is maintained at the popping pressure, but one which will on the slightest accumulation respond with an extremely high lift to take care of the emergency. If a low lift is available at the popping pressure for ordinary relief, a low blowdown may be incorporated, the condition imposed by absolute safety being that at slightly above the popping pressure, the lift will have increased to such an extent that any possible emergency will be taken care of.

Figure 2 shows a diagram from a valve which produces the above action, and is what may be called a second opening valve. Many of this type have been built, and it has been found that with the proper regulation of rings, all valves having 2 rings will produce this action in modified form. Imagine, first, one of the ordinary type blown with the outside ring removed. This would result in a low lift and a very low blowdown. Now suppose that the blowdown ring is in place, but that it is given such a large initial clearance that the valve will act, provided that it has sufficient capacity to relieve the boiler, exactly as before, but if it has not the required capacity the pressure will accumulate and the increase of lift resulting with only the inner ring in action will finally bring the outer ring into action, and a second pop will occur. This pop will result in a high lift, with corresponding high discharge capacity, and the valve size may be proportioned to give the required safety.

That this action can be accomplished in actual practice is shown by the diagram in Fig. 2, which resulted from the action of a 1¼-in. valve on a boiler, or rather boilers, of sufficient capacity to produce the required accumulation. The first pop and sustained lifts are shown at A, the sustained lift being very low. The increase in lift between A and B finally results in the second pop, shown at B, which is the result of accumulated pressure. Between B and C the lift gradually falls as the pressure is reduced, until at C the outside ring goes out of action and the disc drops to a low lift, which is at the given pressure just sustainable by the inner ring. As the pressure is reduced the lift decreases, and after a slight blowdown the valve closes at D with a very low closing lift. This valve had a seat diameter of 1¼ in. and lifted at its highest sustained point about 0.11 in. This lift was the result of about 4 per cent accumulation, and the calculated discharge capacity is 5100 lb. per hr., which is approximately 170 boiler hp.

Features of Design

Careful design will allow of bringing the second pop down very near the first one, and the limits of regulation may be so built into the valve by limiting the possible up and down motion of rings, that this second pop will always come within a given range of pressure. This type of action has many advantages to recommend it. The absence of sudden excessive changes in relieving capacity and the low lift at closure are evident from the diagram. It is clear that if a boiler had 2 valves of this type, the second might be set to blow at a pressure corresponding to the point O on the diagram, so that the 2 valves would be able to handle the boiler at all ordinary times without the second pop, but in the case of emergency both would rise to the second pop lift. The installation would then be essentially a low lift installation, but would have all the advantages of high lift in the case of emergency.

Tires and wireless telegraphy—the two would not be suspected of association, yet sending wireless messages long ago ceased to be a luxury with The Goodyear Tire & Rubber Co., of Akron, Ohio. Wireless plays a large part in the company's business.

About 3 yr. ago, the company conceived the idea of using wireless to save time in communicating with its office in Detroit.

Last summer when the Society of Automobile Engineers held its convention on the S. S. Naronic, in the Georgian Bay, one of the features of the convention was the daily paper published on board the steamer. News of the outside world was furnished by the Goodyear Detroit wireless station.

The equipment is unique in having 3 coils arranged in a series to give a flow of constant intensity. So even and intense is this flow that the operator can receive and transcribe at the same time on the typewriter. Messages are often transmitted to Detroit and an answer returned in 10 min. A record of 4 min. has been established for this performance.

The wireless is also a great time saver in establishing communication between the Goodyear headquarters and its numerous branches in the West. By wireless to Detroit and relaying by telegraph from that city, valuable time is gained in getting in touch with these branches.

Messages are often "picked up" from Arlington, Key West, Porto Rico, Cuba, and Panama, and occasionally, when weather conditions are favorable, from ships on the Atlantic Ocean. Not infrequently an S. O. S. signal from a storm-driven freighter on Lake Erie is detected. At times the Goodyear station at Detroit has been the only one on the lakes, not incapacitated by the violent storms, and has been of inestimable value in transmitting messages to endangered vessels.

Recognizing that there is no greater obstacle to trade between nations than complicated and confusing tariff systems, of which those in South America with their fines and penalties are among the most complicated, the Bureau of Foreign and Domestic Commerce, Department of Commerce, has prepared a report that covers extensively all the obscure points. It is the first complete report on the subject that has ever been made and is one of the most important of the recent attempts to promote a better understanding with the South American countries and to increase our trade with them. The report is entitled "Tariff Systems of South American Countries," Tariff Series No. 34, and will be on sale shortly at a nominal price by the Superintendent of Documents, Washington, D. C. and by the district offices of the Bureau of Foreign and Domestic Commerce.

GAS POWER APPARATUS

Producers, Engines and Industrial Applications

Two-Crank Four-Cylinder Combustion Engine

DOUBLE OPPOSED ARRANGEMENT WITH OPPOSITE PISTONS CONNECTED. BY C. W. SHAFER

OF design radically different from other motors on the market is that manufactured by the Field Motor Co., at Grand Rapids, Michigan. It is of the horizontal type, double opposed, and operates on gasoline, kerosene or distillates. It has but 2 cranks and 2 connecting rods for 4 pistons, which makes possible such compactness of construction that it occupies a space of only 12 by 23 by 14 in. Its weight is 200 lb.

Pistons are joined by tie rods which practically gives a continuous piston. The tie rods have sliding fits on each side of the cranks and also on the top and bottom of each crank shaft bearing, so that the rods have no room for play and the amount of vibration is reduced to a minimum.

Any standard carburetor may be used with the engine, located above the cylinders, to deliver the charges down through the manifold. One manifold only is used for 4 or 8 cylinder engines. Use of kerosene is made possible because the charges are preheated by the exhaust, as the intake and exhaust manifolds are cast

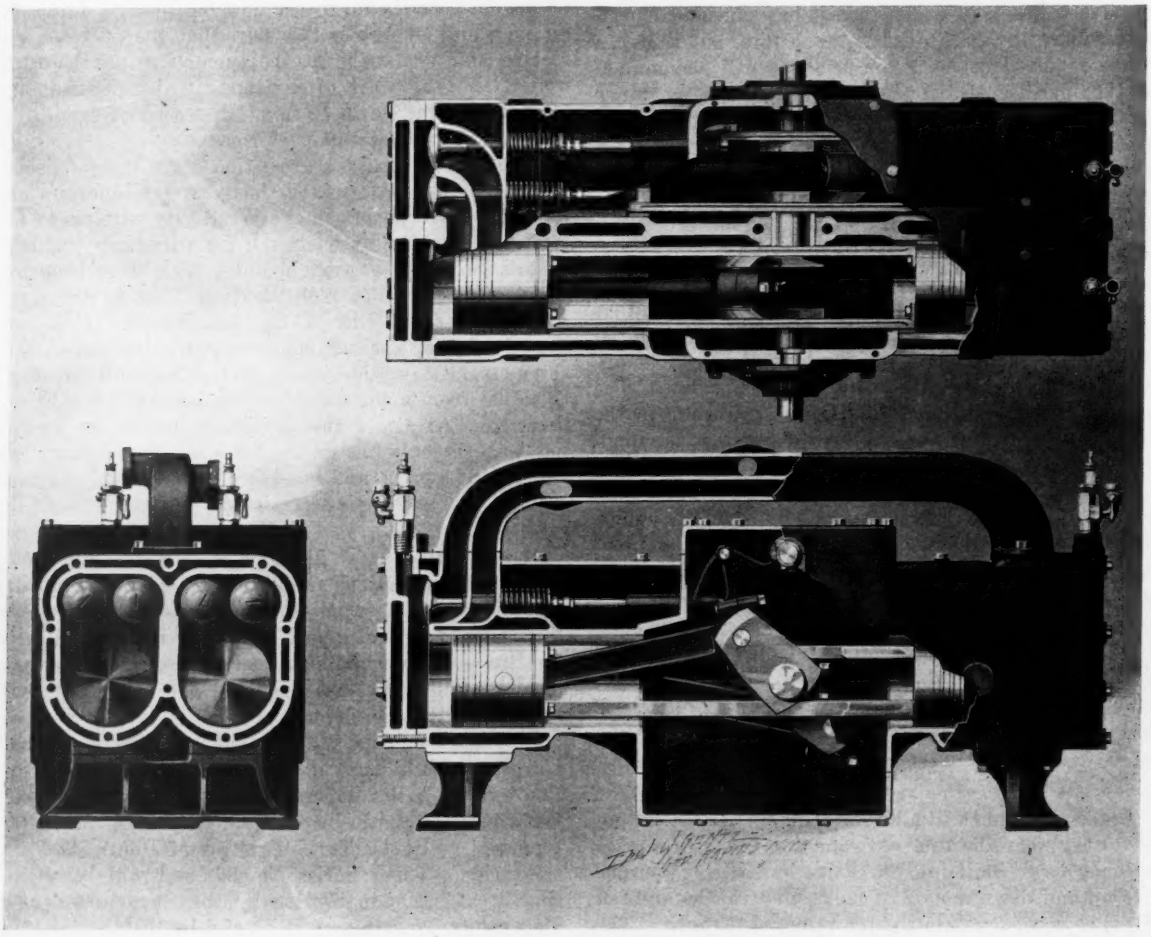


FIG. 1. SECTIONAL VIEWS OF FIELD MOTOR

together, giving large interchange of heat.

Gasoline is used for starting the motor, the 2 tanks being piped to a 3-way cock which is operated for the change to kerosene, when the spark is delayed for a second. By actual tests 1 gal. of gasoline has been used for starts for 2 weeks. The remainder of an almost continuous operation was on kerosene. No readjustment of the carburetor was necessary in changing fuels.

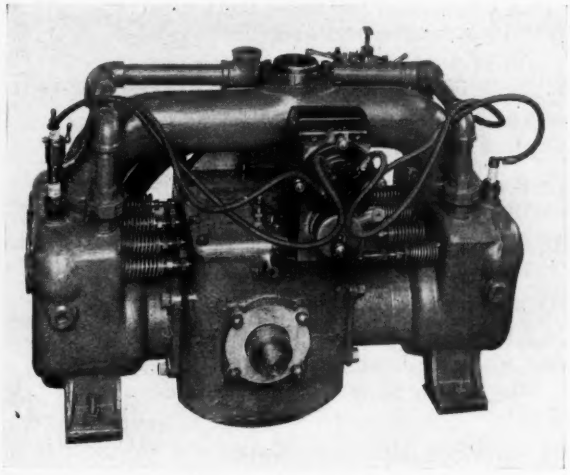


FIG. 2. EXTERIOR OF FIELD MOTOR

With the unusual arrangement of the manifold the charges are fired clockwise, 1, 2, 3, 4; a perfect balance is thus secured. With an 8-cylinder motor, several of which are now in use, 2 explosions occur for every revolution of the crank shaft.

But 3 parts are removed to open the interior. The heads are removable and also the top enclosing plates. The pistons carry the connecting rods and excellent lubrication of wrist pins and cylinders is secured by splash system. A set of enclosed spiral gears operate the cam shaft and magneto, and an adaptable governor, easily attached, will permit the engine to be used for stationary purposes. The engines are now being used in tractors, trucks, automobiles and motor boats.

U. S. CIVIL SERVICE COMMISSION announces an examination, Aug. 29, for supervising marine engineer to fill a vacancy in the position of marine engineer under the Quartermaster General of the Army, War Department, Washington, D. C., at $3500. Apply for Form 218.

Changing from Producer to Natural Gas

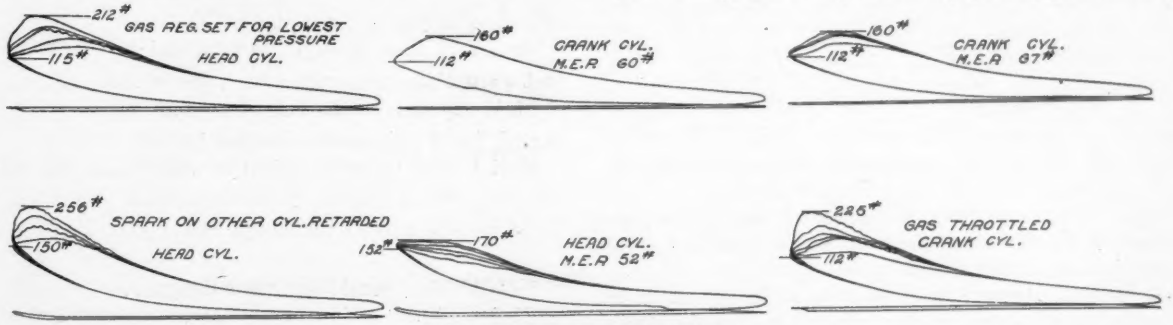
BY J. O. BENEFIEL

IN our plant is a 2-cylinder tandem gas engine, 17¼ by 19-in. cylinders, 210 to 214 r.p.m., rated 125 hp., on producer gas and 150 hp. on natural gas.

We have been running it on producer gas until about 4 months ago, when we got a supply of natural gas again, which was piped to the engine with a meter on the line. After changing the proportion of the mixture to suit the change in heat value in the gas, we found we were using on an average between 26,000 and 27,000 cu. ft. in 10 hr., and no adjustments along usual lines reduced this perceptibly.

We found after much worry, however, that by placing a 6-in. valve on the air inlet, throttling the air supply and at the same time setting the proportional valve by which the governor cuts off the charge of air and gas to suit the load for a very small gas opening, we could operate the engine 10 hr. on from 8000 to 10,000 cu. ft., a saving of 17,000 cu. ft. of 30-cent gas or about 65 per cent of a reduction.

We must give due credit to the hearty co-operation of our assistants in arriving at this satisfactory result. On tests with the indicator and gas meter, we find we are using from 7.13 to 7.5 cu. ft. of gas per i.hp. per hr.; this would equal about 8.45 cu. ft. per b.hp., giving the gas a heat value of 1124 B.t.u. (our city chemist claims it analyzes that). We are inside of 10,000 B.t.u. per hp. per hr.; but, allowing that there might be some error in the meter and indicator, both of which are new and of a good make, we are unquestionably getting good results, and if we were generating electricity with the engine we could put a kilowatt-hour on the switchboard at a cost that would make the central station hump.



CARDS TAKEN FROM GAS ENGINE

The engine is rated at 150 hp. on natural gas, but is indicating 123 to 140 hp. I think if we had at least 50 hp. more load, we could get better results.

We show a few indicator diagrams picked at random from the many we have taken. They all show what looks like late ignition, but the spark checks up 37 deg. early and we have had it earlier; in fact, we have had it all the way from no advance to 45 deg. advance. Of course, more load would overcome this apparent lateness of ignition. When we used producer gas, the engine gave a good diagram, showing the explosion taking place on time with the same spark setting. The maker of the

engine in his instructions says, set the spark at 20 deg. early for natural gas and 45 deg. for producer gas.

Possibly, and it seems so to me, this gas is slow burning; it is claimed that the higher a gas is in methane, the slower it will burn.

Experimenting will not cease until we get an indicator diagram that suits us and have it thoroughly settled that we are getting all that is possible out of a foot of gas; we believe that we can do better as to fuel consumption.

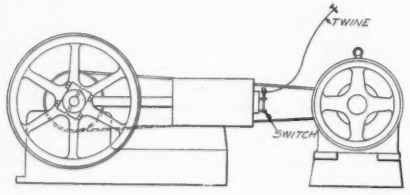
Trying to shoot the crank off with a cylinder full of explosive is some interesting game. We have 2 3 by 3-in. bars across the back cylinder head, held there by 4 1¾-in. rods running forward to the frame. These 4 rods figure up an ability to take care of the force of the explosion by themselves; we just put them on there to make sure it would shoot toward the crank every time.

I have diagrams showing pressures of 300 lb., but those taken lately do not show so high.

Novel Gas Engine Safety Stop

IN THE oil fields, I have seen a man looking after several gas engines, each one several hundred feet from the other, which, outside of oiling every 2 or 3 hr., required little attention.

One engine was running a dynamo furnishing current for 3 pumps, one of which ran nearly all the time, while the other 2 were switched on at any time, but rarely both at the same time. When this did occur, the sudden starting load was too much for the belt, which would fly off the dynamo and coil itself around the



TWINE USED AS SAFETY STOP FOR GAS ENGINE

engine shaft and pulley, raising—dust around the place. Warned by the noise, the man would run to stop the engine and put the belt on again.

Material damage had never been done, and as the plant was of secondary importance, so that shutting it down was not a crime, the attendant rigged up the following safety stop. He fastened one end of a strong twine to the handle of the engine ignition switch, passed this twine inside the belt and tied the other end to a nail on the wall, so that whenever the belt flew off, it carried the twine with it, pulling open the switch and stopping the engine. It was certainly a simple method and saved the run, but not the steps, because the belt had to be put on again. CHAS. LABBE.

CONCESSIONS HAVE BEEN GRANTED by the Government of Chile as follows: to Santiago Schweitzer for installing and operating an electric light and power plant at Calbuco; to Carlos M. Coggiola for an electric railway from Santiago Blanqueado to Plaza Argentina, with branch to Santiago; to Keller and Widermann Co. to supply San Jose de la Mariquina with electric light.

The Gas Engine's Lament

BY L. E. L.

OUT in the scrap pile a gas engine lay,
Broken too bad to mend.
And it moaned in a helpless sort of a way:
"To think that this is the end!
Why I was made a model machine;
All said that I was the best e'er seen,
With my brass work bright, and my jacket green,
That I was a pleasure to tend.

"But now they have dumped me out in the scrap,
To rust with the rain and dew;
And for me no one cares a rap,
Though my years are as yet but few.
My gland leaked bad and nothing would pack it.
I ran out of water and cracked my poor jacket,
And whenever I ran, I made such a racket,
But nothing there was they could do.

"I ran with hardly any attention,
But did the best that I could;
But there's one whose faults I really will mention:
My engineer's head was of wood.
He let me get hot in almost every bearing,
Never greased my poor cams to keep them from wearing,
And from daylight till dark he stood around swearing,
And saying that I was no good.

"He gave me gas that was mostly CO_2,
And with H he thought to save coal;
And when I'd protest with a back fire or two,
He'd expound on the fate of my soul.
The oil that I got was the cheapest he had,
And I filled up with carbon in a way that was sad;
But I never was cleaned, be it ever so bad,
As long as I made the wheels roll.

"The 'Old Man' would say, 'Her designer
Had ought to design never more,
But with dynamite fill 'er and cram 'er
And blow 'er to the heavenly shore.
If I couldn't do better I'd not even try,
But go out in the yard and lie down and die;
Why the noise that she makes beats the 4th of July.'
(Bang) 'Just list to her roar.'

"One day on a bad pre-ignition
From the crank I broke off the pin,
Then out through the head went my piston,
And a sorry sad fix I was in.
That was my finish, I admit it with pain,
For they soon chucked me out to soak in the rain,
And then with a steam plant they started again,
Having piled me here, broken, all in."

LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

Engine Repairs

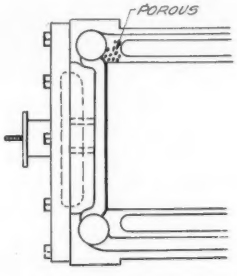
THE FIRM of consulting engineers with which the writer was connected, secured the contract for a new plant in a factory in the East. The old equipment was to carry the load until the new was ready.

One of the engines in the old plant was of the slow-speed spring lever Corliss type and had seen many years of service. The valve ports had been rebored and new valves put in, before deciding to put in a new plant.

The engineer exhibited to me some cards in which the terminal pressure on the crank end was high and looked as if the steam valve was leaking. Accordingly, the steam valve was taken out and found to have a good bearing.

The piston was examined and tested under pressure for leakage, and passed as satisfactory.

In going through the engine room a few days later, the engineer had disconnected the pipe that supplied



LOCATION OF PORES IN CASTING

steam to the jacket on the head from the cylinder wall jacket because one of the fittings leaked, the steam being shut off by a plug cock.

A considerable volume of steam escaped from the crank end head jacket connection. The following Saturday the piston was removed and a search made for the leak, and located as a porous area in the crank end of the cylinder casting, as shown in the illustration.

To work on it made it necessary to unbolt the cylinder from the frame and move it back so the front head could be taken off.

The porous area was filled with tinfoil and then thoroughly gone over with a peen hammer. The several parts were reassembled and on starting Monday a satisfactory card was obtained and the absence of the leak proven by disconnecting the jacket pipe and noting that no steam escaped.

In another plant a small high-speed engine was located parallel with the engine room wall, which was decorated with a 10-gal. can on a bracket and piped to feed oil to the eccentric. Trouble had always been encountered in keeping the eccentric cool.

An examination of the machine showed that the parts were poorly designed, being too small even for the rated load. Careful investigation showed that the hub of the eccentric was so thin that when the setscrews securing the eccentric to the shaft were tightened, the side of the hub in which the screws were, was forced away from the shaft.

The eccentric was taken off the shaft, drilled and tapped for 2 more setscrews on the opposite quarters and replaced. Care used in tightening up the 4 setscrews evenly cured the trouble. RECEIVER.

Saving the Waste Steam

THE AVERAGE temperature of the products of combustion leaving the boiler is about 475 to 550 deg. F. (246 to 287.5 deg. C.), and sometimes higher, depending on the load, draft and other conditions. In many cases, especially in the larger plants, it has been found advisable as well as economical to place an economizer in the path of the waste gases after they leave the heating surface of the boiler and before entering the stack, through which the feed water passes on its way to the boiler. The economy derived from this arrangement is considerable, though in some cases it probably would not be feasible or a paying investment.

In some plants, the conditions are such that a considerable part of the steam generated is used for heating in some type of heating system. Where the heating and ventilating systems are combined, and of the indirect type, a large quantity of air is passed over the heating coils by the fan, thence through the ducts into the rooms to be heated. In order to conserve some of this heat wasted up the stack, it would seem that an indirect heater could be arranged and installed in the breeching through which the hot gases from the boiler would pass and heat the fresh air drawn through the heater in the same manner as steam is used in the indirect heating system. This would, of course, call for a far different type of heater from that used for steam; but there is at least one company which manufactures heating and ventilating apparatus that makes a heater of this type.

Utilizing some of this heat in this manner would lower the stack temperature, which would reduce the draft, and the draft would be further reduced in passing through the heater on account of the restricted passage. This might make it necessary to install an induced draft system to give the stack capacity enough to handle the boilers when working at full load. In many of the business buildings which are many stories high, there is more draft than is needed due to the high stack. It

would be necessary to provide some form of a blower or scraper similar to that used in economizers for the purpose of keeping the heating surface free from the accumulation of soot. This arrangement would be of advantage during the heating season only, but probably would save considerable coal during the season.

There is another source of heat which, in one instance at least, is being used to heat work rooms such as carpenter shop, machine shop, etc., located near the boiler room; that is by means of the hot air over the boilers. Where the air is passed through a cloth filter to eliminate the great part of the dirt it may be used for heating without giving trouble from this source. This requires a fan driven by either a small engine or preferably an electric motor, and the circulation of the air over the boiler will increase the radiation from the boiler to some extent. This system, however, will provide a considerable amount of hot air for heating at a small cost, and would also make use of much of the heat that is wasted through blowing this air to the outside of the building for the purpose of providing ventilation.

J. C. HAWKINS.

Card Criticism

REFERRING TO the indicator cards by J. D., page 622, July 15 issue of Practical Engineer, the writer desires to state that the trouble with these diagrams is due to depending on getting the proper amount of lead or port opening by making adjustment on the individual valve rods.

This is a common practice, and no matter how much lead is given in this way the result will always be a drop in the pressure from the beginning of the stroke to the point of cutoff. The proper method for setting the valves of a Corliss or similar type of engine is as follows: Disconnect the hook rod, center the wristplate, and adjust the radial rods so that all 4 valves line up to the lap marks on the seats, loosen the eccentric on the shaft and roll around the shaft in the direction in which the engine runs until you have about 3/16 in. lead on the steam valves, tighten the eccentric and take a diagram; if the admission line is not at right angles with the atmospheric line on both ends of the diagram, move the eccentric for more or less lead until at least one end of the diagram is at right angles to the atmospheric line, adjust the other valve by use of the radial rod. The exhaust valves can now be set to suit by lengthening or shortening the radial rods connecting the valves. The idea of getting the lead by advancing the eccentric is to have the high portion or large diameter of the eccentric open the valve at the beginning of the piston movement, thus giving the fastest opening possible at the time when most needed. Valves set as described will invariably give a horizontal steam line from the point of admission to the point of cutoff and the maximum economy in the use of steam.

The amount of compression best to use is one of personal preference; but during the past 10 yr. it has been mounting upward until at the present time 60 per cent and even more is being used on engines of very moderate piston speed, with the result that there is less keying up on the brasses and no loss in economy due to the higher compression.

I fully agree with Mr. Wallace as to the economy to be gained by a shorter cutoff; but if these cards are a fair average load condition, then a larger cylinder would be more wasteful during the lighter load periods than the reduced cutoff would make up in the heavier load periods, and the same can be said for the increased speed, which increase of speed would not only require a change of pulley at the governor, as Mr. Wallace states, but would also require a new engine pulley or a larger receiving pulley on the main shaft.

Increasing the steam pressure is the logical remedy; but if J. D.'s boilers are limited to 100 lb. pressure, and he is carrying that pressure and has a 10-lb. drop at the throttle at present, his best and cheapest remedy would be to increase the diameter of the riser above the throttle valve, which will give an increased pressure at the point of admission. Personally, I do not think his conditions would warrant even this small expense. C. E. C.

Remedy for Pump Valve Trouble

WE HAD EXPERIENCED considerable trouble with the disc valves used in our ash ejector water supply pumps. The pumps are high pressure design, being required to deliver salt water at 500 lb. pressure at the nozzles of the ash ejectors.

We tried many different kinds and makes of flat disc valves, hard rubber, fiber, metal, and combination of metal and rubber, but trouble was found with all of them. The hard rubber discs became cracked and

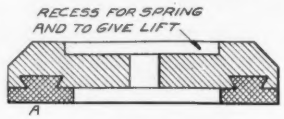
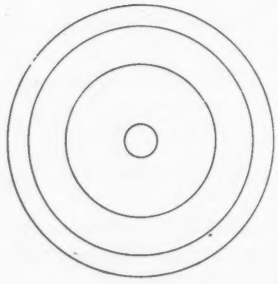


FIG. 1



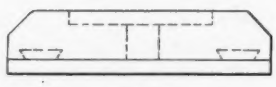


FIG. 2

FIG. 1. CROSS SECTION OF PUMP VALVE FACED WITH WHITE METAL

FIG. 2. PLAN AND ELEVATION OF VALVE DISC

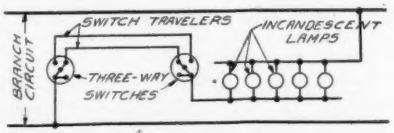
broken, many getting adrift and into the delivery pipe, plugging up the nozzle holes. It was thought that the pressure of water against the delivery valves caused them to bend upward at the edges, so flat brass discs of the same diameter were placed over them, but they still broke. We then tried fiber discs, and had worse luck with them, for they did not stand up long in the hard service required. The layers of fiber separated and

the valves swelled up; this prevented them from lifting the amount necessary to supply the volume of water, and many went to pieces. Our next effort to overcome the trouble was flat metal valve discs, of composition. With these we had fairly good results until the valve seats were worn, when the water pressure would leak back into the suction chamber. We then put the question up to the superintendent, and the valve shown in Figs. 1 and 2 was the result of his efforts. These valves have cured our troubles and are doing excellent service, since their installation 4 mo. ago. I opened the valve chest to look at them and they were in fine condition.

The valves were cast and machined by a nearby job shop at a small expense. They are common round, flat, bronze or composition discs of the same diameter and thickness as the original hard rubber discs that were in the pump. These bronze discs were put in a lathe chuck and a circular dovetail groove cut in one side and a recess on the other side. The dovetail groove and face of the valve discs were tinned and then filled with white metal; this, when cooled, was peened in. We used old metallic piston rod packing melted up, for the white metal, as it is of the right hardness and wearing quality, and stands up better than babbit metal. The white metal faces made on the discs form their own seat and at the inspection after 4 mo., there was little wear and only a small impression of the valve seat caused by the constant lifting and seating. When these valves do become worn, they can easily be re-metaled and used again. C. H. W.

Three-Way Switch Connection

IN THE ISSUE of July 1, page 585, connection is shown for a 3-way switch for 2 points of control, the 3-way switches having both sides of the circuit brought into the one switch. While this has been used in many places, it is not the best way of handling the connection, as has been called to our attention by Chas. H. Trapp, who submits the method of connection shown



CORRECT 3-WAY SWITCH CONNECTION

herewith as being fully as simple and conforming, in every way, to Rule 24-C of the National Electrical Code, which says that 3-way switches are considered as single-pole switches, which would prohibit the bringing of both sides of the circuit into a 3-way switch.

Mistakes

A POWER PLANT chief in the East has found that he can select the best men by asking this staggering question, "What mistakes have you made?"

He won't hire engineers, firemen, oilers or other employes who have never made a mistake or who claim they never made a mistake. He holds that mistakes are an invaluable asset, and it is unlikely that they will occur in his plant if they have occurred elsewhere first.

Most of us make mistakes, but we pride ourselves in not making the same mistake twice. And after having made our quota of mistakes we consider ourselves "experienced." Experience is generally viewed from the opposite standpoint by other employing engineers, and by ourselves, but it is evident that it can also be logically viewed from the "mistake standpoint."

Many engineers blush a violent red when mistakes are mentioned. They stammer, stutter, hem and haw a great deal while talking about them.

True, it is a rather delicate subject. We *should* be ashamed of our mistakes. Yet, if mistakes occur with decreasing frequency, and if we are doing more work than ever, it is a good sign and we should be able to face the employing chief with a clear conscience and a strong argument of greater efficiency and more experience.

Sometimes mistakes are mental only—not actual. No accident has occurred, nobody has been harmed except that the owner has perhaps lost some money through inefficiency. As soon as the mistake is rectified and the coal-saving apparatus installed, our consciences become easier. Mistakes needn't necessarily be disastrous. Nobody but yourself may ever know about them.

But when an employing chief like the above asks, "What mistakes have you made?" it is apparent that all should be included in our tale—the more the better.

N. G. NEAR.

Hot Steam for Tube Blowing

ON PAGE 619, issue of July 15, N. G. Near makes a statement that has long been one of the ideas I have held with regard to blowing soot from heating surfaces of boilers. When blowing tubes, etc., with the regular old style hand lance, the steam never could be any hotter than the heating surfaces of the boiler, consequently I contend that there is a lot of moisture blown onto the heating surfaces; this moisture mixes with the soot, and on account of the heat of the gases passing through the setting, this moistened soot is baked onto the heating surface instead of being thoroughly removed by the blowing.

I have been in a power plant where steam was generated at 150 lb. gage pressure, and 100 deg. superheat, and this superheated steam was used for tube blowing, and even with this steam, soot scale deposits of considerable quantities were found on the heating surfaces, which had to be removed by hand scrapers and brushes at regular wash-out time.

The reason this superheated steam caused soot scale to form, I believe, lay in the fact that the great length of hose required radiated large quantities of heat, thus lowering the temperature of the steam almost to the temperature of saturation; also, that the hand lance is inserted into the setting through inspection doors and soot openings provided for the purpose of soot blowing; and on account of the difference of atmospheric pressure between the inside and outside of the boiler setting, considerable quantities of cold air rush into the setting through the opening through which the steam blower is inserted into the setting, thus the steam blown into the tube space and onto the heating surfaces is surrounded by comparatively cool air, which rapidly condenses

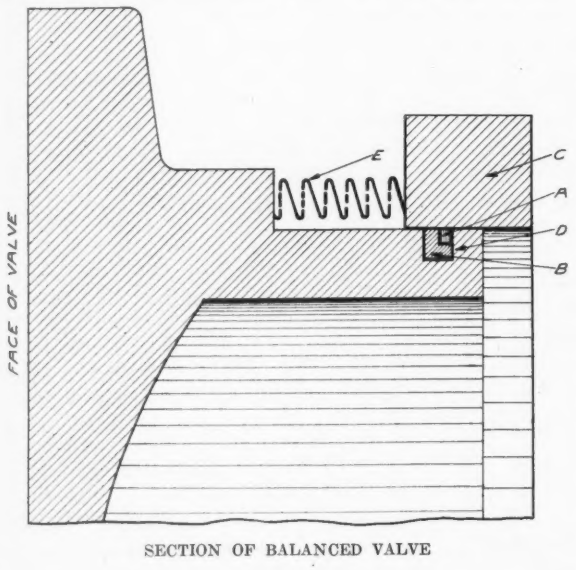
sufficient of the steam delivered from the soot blower pipe to cause enough moisture to form soot scale deposits.

A consideration of these conditions will show why ordinary saturated steam, used for soot blowing with a hand lance, must be more or less of a failure.

Of late years, I have become a firm believer in mechanical soot blowing devices, for many good reasons. We all know that the gases leaving the boiler setting are ordinarily much hotter than the steam contained in the boiler. Now, if we insert in the setting a suitably designed blower element so fitted with nozzles as to project jets of steam over or through the heating surfaces, so as to blow off the soot thoroughly, without opening any soot doors or inspection doors, then the steam thus projected onto the heating surfaces must pass through this blower element that is permanently located inside the setting and subjected to temperature conditions considerably hotter than the steam being used and the steam, after leaving the element, is projected into temperature condition that is always hotter than the steam; thus, the steam is superheated and the cleaning blast is hotter than the heating surfaces, instead of colder and damp. H. W. BENTON.

Repairing a Leaky Balanced Valve

IN THE accompanying illustration is shown the section of a balanced valve, of a well-known make of automatic high-speed engine. C is a heavy cast-iron ring on the back of the valve made steam tight by the 2 small rings in the groove; B is a sectional ring, while A is a snap ring; C is held out against the steam chest cover



SECTION OF BALANCED VALVE

by springs E. The valve on one such engine under my care developed a pronounced slap which was not only annoying but also resulted in wasting considerable steam. I tried more tension on springs E, but all to no avail; I then dressed off the head of the valve stem where it was attached to the valve by a saddle, but still no relief; I then removed the small packing rings and found that at point D the snap ring had worn a recess in the slide of the groove, leaving a shoulder at the point where A fits over B. This allowed A to be forced out against the inner side of C, which had a depression worn in it, thereby preventing C from being forced out to the steam chest cover. I sent the valve to a machine shop and had the shoulder turned off, resulting in a lasting cure of my trouble. N. W. DUELL.

Some High Water Troubles

DURING my experience with steam plants, I have found the cause of many automatic steam devices not giving the service they should is high water. I have read several complaints in different engineers' journals of reducing valves that would not regulate with any degree of accuracy. My first trouble of this kind was in an automobile tire factory, where the steam temperature was required to be kept at a certain degree to cure the material properly. The valve used was considered one of the best on the market. After considerable loss, much worry and work, I found the trouble to be caused by high water carried in the boiler at night. The water in these boilers, as is true in most cases, carried much foreign matter in suspension. This valve had a close fitting piston with water seal grooves which became filled with the suspended matter so that their function was destroyed and caused the piston to stick and of course the valve would not operate properly. After this discovery, the water was carried at the proper level and no more trouble was experienced with the valves.

I have since had the same trouble with other makes of reducing valves, and also a damper regulator that was fitted with a piston having the water seal grooves. Whenever they failed to operate upon taking them apart, these grooves were invariably packed with foreign matter carried over by the water. After soaking in kerosene and thoroughly cleaning, the trouble was gone, and by keeping the water the proper level in the boilers we have the remedy. T. O. VICKERS.

Comments Regarding Homemade Valve Stand

ON PAGE 666 of the Aug. 1 issue of Practical Engineer appears an article headed "Homemade Valve Stand," signed by H. E. Weightman, who states that the homemade floor stand advocated by M. Saller, in the June 1 issue, is a device, the cost of which would be several times as much as the regular stand sold by the several manufacturing companies and says that before Mr. Saller advises such things he should first determine their cost.

I agree from an economic standpoint that Mr. Weightman is correct; but there is a different side to the question, and perhaps Mr. Saller has been up against it a time or two. Mr. Saller's idea gives an incentive for improvement of their condition and convenience to those whose employers stumble every day in the week over a dollar to pick up a penny. JOHN CORLISS KAHL.

ACCORDING TO Commerce reports, a firm in Cuba is desirous of representing American manufacturers of electric motors, gasoline motors, electric fans, boats, and electrical supplies.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Walschaert Gear in Stationary Service

On page 468 of the May 15 issue, under heading, Retaining Equal Cutoff, Mr. Wallace states, among other things, that the Walschaert valve gear is sometimes used in stationary practice. I would like to ask Mr. Wallace just how the governor is connected to this gear and what type of governor is used; whether it is the Porter type operated through the medium of a link, or whether it is used with a centrifugal inertia shaft governor. Also, for what special work is this type of gear used in stationary work? F. V. B.

A. The Walschaert valve gear, as applied to stationary practice is confined to such duties as require economy, simplicity and service enough in period of rotation as will permit "hooking up" the gear after starting it.

In some localities where mines can be worked profitably only when the ore can be raised cheaply, and where it is difficult to secure men capable of caring for engines of the more refined type, a hoist with balanced piston or flat valves functioned by a Walschaert gear gives good results if "hooked up" when running. This gear can be driven by an eccentric on the shaft, the same as any other type of gear, even though locomotive practice with it makes use of a "return crank" outside the drivers.

There is no reason why a governor should be used on a hoisting engine using a Walschaert valve gear, any more than on a locomotive, as both machines run under control of a throttle valve which the operator uses as required by the load. There is no reason, however, why a governor could not be attached as a speed-limit device, so that there would be no danger of overspeeding with disastrous results, should the load be thrown off. A common throttling governor could be used for this purpose admirably, the same as it is used on thousands of traction engines equipped with the Woolf gear.

The writer once saw a curiosity in the shape of an engine which was made from the cylinders, saddles and front drivers of a standard locomotive from which the boiler and other parts had been removed. The main frame had been sawed off back of the driving box, and the whole outfit set on a foundation with considerable display of strap iron and bolts, which did not entirely prevent the machine from sliding around. A crude band-wheel had been placed on the shaft and belted to the lineshaft of the railroad shops, and the old style Walschaert gear was allowed to remain, the reverse lever having been located on a quadrant bolted to the floor convenient to the engineer who made it a practice to "hoist her over" whenever he was required to make a quick stop. This outfit had a common throttling governor. When starting up, the engineer "dropped her down in the corner" in regulation railroad fashion; but as soon as the engine came up to speed, he "hooked her up" to a point where constant practice told him that it worked the best.

It would not be practicable to use any type of shaft governor with the Walschaert gear, as the unbalanced weight and the inertia of the several parts which are hung more or less free, would almost prohibit even the crudest sort of regulation. A governor of the Porter type could be constructed so as to handle the gear, but it would, of necessity, be quite massive and possibly so expensive and complicated as to preclude the use of an engine with this gear on as being too hard to care for.

The Walschaert gear is particularly adapted to reversing engines, the same as the Stephenson link motion would be. It would also be practicable to use a Nordberg poppet valve governor, which would in itself be an economical feature. G. H. Wallace.

Proper Connecting Rod Lengths

How is the length of a connecting rod determined when the length of the stroke is known? Some say that 2½ times the stroke is the proper length of a connecting rod; this relates to steam engines.

2. What is the shortest connecting rod that can be used for an engine having a 2-ft. stroke, also the longest that can be used, and still get the best results as far as power is concerned? Please give me the rule for finding this, as I have never been able to find data on this point.

As you know, if the connecting rod is coupled too short, the angle the connecting rod makes with the guides of the cylinder is too short or great, and some of the power is lost; but in having a rod, say, 4 or 5 times the length of the stroke, I don't know how it would be. F. T.

Answers

There is no definite rule for determining the ratio of the length of connecting rod to the length of stroke. This is simply a matter of custom rather than anything else.

As you say in your letter, the longer the connecting rod the less will be the side pressure brought on the crosshead guides, and therefore the less the friction at that point. On the other hand, a long connecting rod means a longer engine frame, which, of course, takes up more room and is more expensive to build.

2. It has been found that in practice that a connecting rod 2½ times the stroke, or 5 times the crank, gives reasonably good results, and is about as short as can be used without bringing an excessive pressure on the crosshead guides. The use of a longer rod is simply a matter of making a more expensive engine. There is no objection to using any greater length except that of cost.

I believe in some small engines for high speed, a length of 4 cranks, or 2 times the stroke is used; but I do not think anything shorter than this has ever been found desirable. In some large Corliss engine work, a length up to 6 and 6½ cranks, which would be 3 or 3¼ times the stroke, has been used because the swing of the parts back and forth was to be reduced to a minimum.

In a high-speed engine, the longer the connecting rod, the heavier it becomes, and the side strain due to the swing back and forth of the connecting rod across the center line may become more serious than the side pressure on the crosshead guides, due to the angularity of the rod. A. L. R.

Preparation of Commutator Filling Compound

In an article entitled Oil Leakage, by Gordon Fox, published on page 451 of the May 15, 1916, issue of this paper, the author advises the use of a paste composed of powdered mica, plaster of paris and shellac for the repairing of burned and pitted commutators. In what proportions are these ingredients used? F. H.

A. It is hardly necessary to weigh or measure the ingredients. Over a mixture consisting of about half fine mica powder and half plaster of paris pour enough white or orange shellac to bring the mass to the consistency of a thick paste. (Do not use black shellac.) This may then be placed in the pits or slots with a putty knife or similar tool, after which apply sufficient heat to dry the alcohol.

There are excellent preparations on the market for commutator filling purposes and one particularly good is put up by the Westinghouse Electric & Manufacturing Co. Gordon Fox.

Calculation of Hydrostatic Pressure

Our cold water supply is located on the roof in tanks about 110 ft. above the pump. I wish to know how the pressure is figured on tank in basement, which is, according to gage indications, between 65 and 75 lb. per square inch. B. H.

A. The pressure resulting from a head of 110 ft. would be 110 times 0.433, or 47.6 lb. per square inch, where 0.433 is the pressure in pounds per square inch of one foot of water. The difference between 47.6 lb. and 65 or 75 lb. is due to the compression of the air in the roof tanks. There is no way of calculating the exact value of this cushion effect of the air in the tanks except as a difference between the calculated pressure of the water head and the observed gage pressure. W. P.

Repairing Bag at Girth Seam

What is the best method of patching a boiler having a bad bag through which a girth seam passes? W. S. H.

A. As neither size of bulge nor thickness of plate or joint is given, we will assume 5/16-in. plate, single-riveted girth seam and steel rivets 13/16 in. after being driven, pitched 2⅛ in., as the original construction. Suppose the bulge is 24 in. girthwise and 14 in. longitudinally. Then cut out in an oval all of the defective section, place patch on the inside, fullering down to fit at the lap ends, mark rivet holes 2 in. apart, punch ¾ in. and ream out to 13/16 in.; those in lap, one at each end, to be ⅞ in. Countersink all holes on the inside and after rivets are driven, bevel chip the edges of both patch and sheet close to the rivets and calk. The lap of the original seam at the ends can easily be filed and chipped to a bevel. Leaving one side of a patch outside, as is often done, is objectionable on account of forming a pocket.

This, if properly done, will make a tight and lasting job without cutting down the stipulated pressure.

D. O. Scott.

U. S. Government Examination Question

The following list of questions was recently asked in an examination in elementary steam engineering for the position of Electrician Sergeant in the Coast Artillery Service, and as the questions are somewhat different from the usual run, I submit them for publication. Possibly they may serve a useful purpose.

1. Give a description of each of the following, accompanied by a pencil sketch, and state where used: (a) globe valve; (b) gate valve; (c) throttle valve; (d) slide valve; (e) poppet valve; (f) check valve; (g) back pressure valve.

2. State the function of the steam gage; water gage; water column; safety valve; injector; feed water heater; blowoff pipe; damper.

3. Draw a sketch of a steam engine and name and designate all of the important parts.

4. Name 2 types of steam-engine governor and draw a sketch of one and describe its operation in detail.

5. (a) What is the use of a steam-engine indicator?
(b) Draw a sketch of typical indicator diagrams for head end and crank end and locate and name all events and critical points.

6. What is a compound engine and what are its advantages as compared with a simple engine?

7. What advantages are obtained by use of a condenser?

8. State the use of each of the following: (a) lubricators; (b) separators; (c) traps.

9. Name and describe briefly 2 types of pumps, explaining in each case its principle of operation.

10. Explain how you would proceed to set a reciprocating engine on dead center.

Time allowed for this examination was 5 hr. C. J. M

Comments on Power Plant Questions and Answers

On page 620, of the July 15 issue, appear some answers to questions to which the writer takes exception.

In answer to question 1, we are told to introduce several gallons of crude oil in a boiler that is to be laid up for some time, the directions for doing so being given.

In the first place, as the oil depends on circulation due to the lowering water when the blowoff is open to carry it over all interior surfaces, we have no insurance that it will deposit on such surfaces, and this gives the desired protection to the metal.

I have seen boilers so treated, and when opened, part of the interior surface had a heavy coating, while part had none.

When oil is to be used as mentioned and is to be washed out with soda ash, while boiling will remove the greater part of the oil, nevertheless some will remain and cause trouble, and especially when the water contains certain impurities.

Inasmuch as it requires considerable time to boil and wash out a boiler when put up in the manner described, and in some cases may even require new gaskets, the writer does not advocate this method. One of my plants carries a variable load, and as a result, one or more boilers are laid off for weeks at a time. My method of handling them is as follows: The boilers to be laid off are filled with water, into which has been placed 1½ times the usual quantity of boiler compound.

When a boiler is wanted in a hurry, as often happens, all that is necessary is to start the fires, blow off the water to the second gage and cut into the line when the required pressure has been reached.

This method reduces the time the working boilers already on the line may be overloaded and at best the boiler is in service within 4 hr., as against at least a day under the conditions given in the answer originally referred to. In addition, it is believed that the boiler is all the better for not introducing the oil. Whichever method is used, the blowoff should be opened frequently for the first day or two.

In answer to question 4, we are told that advancing the eccentric (steam, or if only 1 is used) will not change the range of cutoff; however, if the eccentric is moved to cause earlier valve movements in relation to the crank, the range of cutoff is shortened because the eccentric reaches its greatest throw that much earlier in the stroke of the crank and begins its return travel.

When any changes in valve gear are made, always take the precaution to move the governor into the highest and lowest positions and make sure the safety stop is in working order. RECEIVER.

IN THE July 15 issue, page 620, W. P. has a list of questions and answers, number 4 of which I do not consider correct. He plainly states that the range of cutoff would not be changed, and I will endeavor to explain how it will be changed.

With the eccentric set 90 deg. ahead of the crank and with no lap or lead on a common Corliss engine, it is impossible to get more than a ½ cutoff, for, as the eccentric moves 90 deg. more, or a total of 180 deg., it starts on its backward travel, therefore the cutoff must occur before the eccentric starts backward or travels beyond 180 deg. If not, the crab claw will hang on and act like a positive valve gear. Ordinarily, we have lap and lead, and to obtain the right amount of lead we must advance the eccentric to overcome lap and get lead, and in doing so our range of cutoff is shortened in the same proportion the eccentric is advanced. Therefore, if we advance the eccentric to get earlier release and more compression, we shorten the range of cutoff. Changing the valve rods will not remedy this, as you simply put more lap on the valve to make up for what is lost in advancing the eccentric, and engineers know that the greater the lap the shorter the range of cutoff.

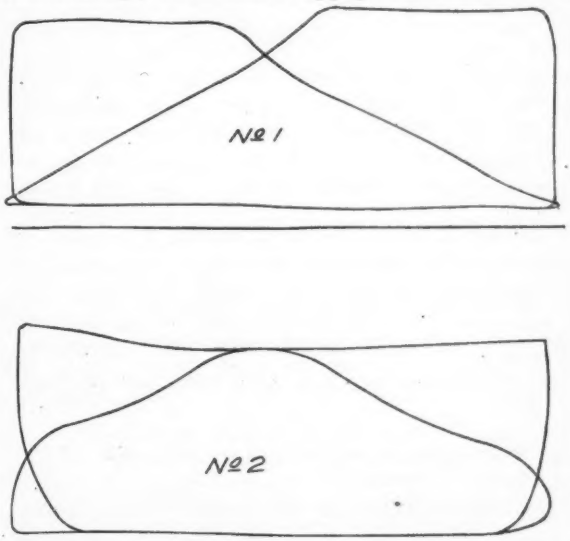
I had a Corliss engine with which I wanted to do the same thing. The first thing I did was to advance my eccentric and change the length of the steam valve rods; this worked all right with a medium load, but with a heavy load the governor would be down on its pin, and below speed; my indicator showed an earlier cutoff than before with heavy load. In advancing the eccentric, the range of cutoff was shortened after I changed the valve rods. The best way to remedy this was to move the eccentric back until the range of cutoff was long enough to take care of the load.

W. N. L.

Why the Twisted Valve Stems?

OUR BEATER ENGINE is a Vilter double-eccentric, 28 by 42-in. running at 90 r.p.m.; it is rated at 600 hp., but is pulling on an average 900 hp.

One night last week, without warning or making any noise, it suddenly stopped. There were no hot boxes, loose bearings, no eccentric slippage and no chance to get a dose of water. When I disconnected the wrist plates, the steam valves worked easily by hand, but the exhaust valve wristplate could hardly be moved. So, deciding that the exhaust valves must be stuck, I removed the rear bonnets and took out the valves, which I found in good condition and all ports clear. By working the exhaust wristplate, I noticed that in the position where the ports should be open, they were nearly closed. This led me to believe that the valve stems must be twisted, which was the cause.



PERFORMANCE OF ENGINE WITH TWISTED VALVE STEMS SHOWN IN DIAGRAM 1; PERFORMANCE OF ENGINE WITH NEW STEMS SHOWN IN DIAGRAM 2

By lengthening the valve rods about ⅝ in., we obtained sufficient exhaust opening to run until the next day, when new valve stems were put in. We had the old stems packed with metallic packing, but put soft packing in the new ones. Now, I would much appreciate the opinion of some engineers as to what caused both exhaust valve stems to twist. Indicator diagram No. 1 shows what the engine was doing after adjusting the twisted stems; diagram No. 2 shows its performance with the new stems. C. D.

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Water Power and Coal Wasted vs. Scenic Spectacles

IN AN address delivered before the Foreign Affairs Committee of the House of Representatives at Niagara Falls, Dr. Edward G. Acheson outlines the use of power at the Falls for various purposes, the industries which have been made possible because of the availability of large amounts of cheap power, and advocates the further diversion of water from the stream for power purposes in order to conserve the coal supply of the country. He says, "I consider it a veritable crime against our posterity to preserve this great natural, inexhaustible resource in its entirety, or as it now is, for the reason of its scenic beauty, while we at the same time press forward to the exhaustion of the coal deposits of our country. We are advised our coal supply will be exhausted in another century. Certainly a goodly time, but still not great as we measure the life of nations. There is nothing visionary or fanciful about this early exhaustion of our coal supply. True, we are told of immense coal fields in Alaska, but one cannot readily imagine the factories of New York, Pennsylvania, Ohio, or in fact any of the states being supplied from these deposits in the frozen North. Let me impress upon you the fact that a century is not a long period.

"I have here a few statistics coming from the U. S. Geological Survey: The production of anthracite coal in 1913 was 91,524,927 metric tons. Compare these figures with the production in 1820, which I find was no more than 365 tons. Here are figures on the production of bituminous coal in the United States: In 1895 it amounted to 124,627,000 metric tons. In 1900 it had increased to 191,256,000 tons and in 1913 it had jumped to the great figure of 478,523,000 metric tons. You will not find it difficult to see the exhaustion of the coal deposits a century hence.

"Perhaps you are not interested in the welfare of the people who will live a century hence; but I assure you that if those people find that a great natural inexhaustible resource for power, as is the Falls of Niagara, has been preserved to them on account of its scenic beauty, while at the same time the country has been denuded of its coal supply to produce power, these faraway people will be very, very much interested in what you and all of us, of this present generation, have been doing. Unless we have already done so, they will find themselves under the necessity of diverting the water from the river for power purposes; hence they will have neither coal, which we will have used, nor scenic beauty, which we are trying to preserve. In closing, gentlemen, permit me to leave with you the question, 'What is the true, the real, conservation of our natural resources? Is it not the full and economic use of the inexhaustible for the preservation of the exhaustible?'"

There has been great hue and cry in the daily press about the preservation of the scenic beauty of Niagara Falls, and, of course, much argument may be presented on that side, but the point which Dr. Acheson makes that we, by limiting any further diversion of water from the Falls for power purposes, are wasting a practically inexhaustible source of power and, at the same time, are depleting a rapidly lessening source of power supply, is one which will strongly appeal to everyone who be-

lieves in making the best use of all natural resources for the ultimate benefit of mankind.

There may be no other places where so stupendous a spectacle of falling water can be seen as at Niagara, but when we balance against the somewhat greater spectacle at the Falls from some millions of cubic feet of water per hour passing, as against the great effort and expense necessary by future generations to replace the power which might be developed from this water, in endeavoring to find a substitute for the plentiful supply of coal, which may be conserved, the argument would seem to appeal strongly on the side of utilizing this energy rather than wasting it.

There are throughout the country plenty of great natural spectacles which may be kept in permanent grandeur without the sacrifice of natural resources or resulting exhaustion of stores which cannot be replaced. Our coal mines once depleted are gone forever. Our great national parks, both the historical parks in the East and the scenic parks in the West, can be preserved without sacrifice of any important advantage; but this cannot be said of hindering water power development at Niagara Falls or elsewhere. Development should be permitted under such conditions as will ensure the greatest possible benefit to the surrounding localities and to the country at large, and the power plants should conform to a general scheme which will add to rather than detract from the appearance of the banks.

News Notes

AT THE Minneapolis Convention, N. A. S. E. to be held Sept. 11 to 16, next, Monday will be devoted to registration at the West Hotel headquarters and in the evening the mechanical exhibition will be opened in the Armory on Kenwood Parkway. The opening exercises will be in charge of Chairman Williams of the local convention committee, and addresses will be made by President Lane Thompson of the Exhibitors' Association and President Walter H. Damon of the N. A. S. E. The exhibit will be open each day from 9 a. m. to 10 p. m.

National officers will receive at 8:45 and an informal dance will be in order at 9:15 in the convention hall of the Armory.

Tuesday morning, delegates will march in parade from the West Hotel to the Armory, where the usual opening exercises will be held with speaking by state and city officials and by the N. A. S. E. national officers. In the afternoon business sessions will be held by the N. A. S. E., by the Ladies' Auxiliary and by the Life and Accident Department.

At 3 p. m. Professor C. F. Shoop of the University of Minnesota will lecture. In the evening the ladies will attend a theater party at the Shubert, and the delegates will have opportunity to study the exhibit.

Business sessions will occupy Wednesday forenoon up to 11 o'clock, when Professor J. J. Flather will speak on The Engineer. Business will be resumed in the afternoon until 3, when H. F. Mueller, president of the state association, will deliver a lecture. Ladies will enjoy an automobile ride at 3:30 and at 4 will join the menfolk in a visit to the Washburn Crosby flour mills.

From 8 to 10 the exhibit hall will be the center of activity, with a stag party following at 11 in the Gayety Theater.

Thursday morning up to 12:30 will be occupied with business and memorial services, and in the afternoon, the convention will be guests of the St. Paul association at the South St. Paul picnic grounds for a barbecue dinner and field day. Meeting of the Exhibitors' Association will be held in the Armory committee room at 4:30, and in the evening the exhibitors will tender their annual entertainment to delegates and visiting engineers.

Final business sessions will be held Friday morning and the closing installation of officers and grand ball will take place at the West Hotel at 8:30 p. m.

Saturday is left free for visits to plants and places of interest about the Twin Cities.

BY RESOLUTION the directors of the American Association of Engineers has extended the time for joining without paying initiation fee to Sept. 1, 1916. The annual dues are $10. After that date the initiation fee will be $2 and for each 500 members secured, above the 1000 mark, the initiation fee will be increased $2. Revision of classification requirements is under consideration, which will restrict certified membership more rigidly than heretofore.

Membership of the association has grown from 30 up to 891 in 14 months, due to active effort in promoting the welfare of engineers along commercial lines and working for the betterment of the profession and the community. The office also serves as an employment clearing house and reports very few members unemployed at present.

THE SARCO CO., Inc., New York, has appointed Newton-Johnson, sales engineers of Milwaukee, as sales representatives in Wisconsin and the northern peninsula of Michigan.

INTERBOROUGH RAPID TRANSIT CO., New York Railways Co., announce the removal of offices from the 59th St. power station to the Cable Building, 621 Broadway, corner Houston St. Executive offices will be on the 4th floor, engineering offices on the 9th floor. Telephone numbers will be Spring 1500, 1501, 1502, 1503 and 1504.

AFTER 19 yr. with the Peerless Rubber Mfg. Co. and several other mechanical rubber companies belonging to the United States Rubber Co., Stephen Roberts recently resigned as advertising manager. He has acquired an interest in the Everyday Mechanics magazine, published at Aeolian Hall, 33 W. 42nd St., New York City.

THE TOWN OF Wickenburg, Ariz., has recently voted a bond issue of $17,000 to be used in bettering the present water works system and installing an electric light plant. Advertisements will soon be published calling for bids, also advertising the sale of bonds on the proposed work. Particulars in regard to this development may be had by addressing the Town Clerk, Wickenburg, Ariz.

Michigan Engineers at Kalamazoo

STATE ASSOCIATION HOLDS ITS 15TH ANNUAL CONVENTION, JULY 19 TO 21

THOSE who journeyed to Kalamazoo declared that the weather man was, in a small measure, responsible for the warm welcome which the reception committee gave them. Activities of the convention, which proved to be one of the most successful held in the state, soon demanded all their attention, however, and the warm weather was overlooked.

At the opening session, held in the New Burdick Hotel, Wednesday morning, July 19, the address of welcome was tendered by City Attorney Schaberg in the absence of the mayor. Short talks followed by F. F. Tesch, state president; E. C. Smith, chairman of the executive committee; O. B. Towne, secretary of the Chamber of Commerce, and F. W. Raven, national secretary.

At the afternoon session, the reports of the officers and committees were read. The credentials committee reported 16 delegates present. Of the 15 associations in the state of Michigan, Secretary Smith stated that 13 associations, with a total membership of 576, were affiliated with the state association. After a number of communications were read, the meeting adjourned.

Gormley, objected to a decision of the umpire, Former State Deputy Moore, and after charging in close formation they proceeded to roll him around in the grass. Ball throwing contests for the men and the ladies were next on the program. After a picnic supper was served by the ladies in a grove near the lake, the return trip to the hotel was made. To the accompaniment of an orchestra, the exhibitors were busy during the evening explaining the operation and pointing out the merits of their devices and products.

At the Friday morning business session, an amendment was made to the state constitution by which a committee on analysis and distribution is created. It will be the duty of this committee to determine the nature of the various reports and resolutions submitted and then pass them to the proper authorities for consideration. Detroit and Grand Rapids offered bids for the 1917 convention, but Detroit was finally selected, and as consolation, the 1918 meeting has been virtually pledged to Grand Rapids.

During the afternoon session the following officers were elected and installed: President, John P. Brown, of Grand Haven; Vice-President, Geo. Bullis, of Grand Rapids; Secretary, E. C. Smith, of Kalamazoo; Conductor, F. Clark, of Detroit; Doorkeeper, G. A. Turnbull, of Flint.

Exhibits were arranged in the ball room of the New Burdick Hotel. The companies represented were:

Everyone reappeared that evening for the reception and smoker given in the exhibit hall. Impromptu speeches, swapping of experiences, and music furnished by a saxophone quartet rounded out the program.

At the Thursday morning session, the convention placed itself on record as being opposed to the plan now being considered by the National Association, which provides for the appointment of delegates to the national convention from the state associations rather than from the subordinate organizations. The plan to hold bi-annual conventions was also opposed. Plans were approved for establishing an employment bureau in the offices of the National Association.

As the state legislature did not meet during the past year, the state license law committee was unable to continue its active campaign of the year previous, when the passage of the license law bill, which it has submitted, was prevented by a few unexpected technicalities. Educational work has consisted largely of informal discussions and debates, although several of the associations have had lectures by men prominent in the engineering profession.

Automobiles conveyed the delegates and visitors to West Lake on Thursday afternoon. A ball game between the engineers and exhibitors was the feature event. In the fifth inning, with the score 15 to 3, favoring the exhibitors, a portion of the crowd, led by Past President

American Steam Pump Co., Battle Creek, Mich.; Anchor Packing Co., Detroit; Kenneth Anderson, Detroit; V. D. Anderson Co., Cleveland; Armstrong Machine Works, Three Rivers, Mich.; Arrow Boiler Compound Co., St. Louis; Bond Supply Co., Kalamazoo; S. F. Bowser Co., Fort Wayne, Ind.; Coon-De Visser Co., Detroit; Crandall Packing Co., Cleveland; A. D. Cutchess, Kalamazoo; Dearborn Chemical Co., Chicago; M. H. Detrick, Chicago; The Edward Valve & Mfg. Co., Chicago; Edwards & Chamberlain Co., Kalamazoo; H. D. Edwards & Co., Detroit; The Excello Mfg. Co., Cleveland; Garlock Packing Co., Cleveland; Hawk-Eye Compound Co., Chicago; H. W. Johns-Manville Co., Cleveland; Keystone Lubricating Co., Chicago; Lunkenheimer Co., Cincinnati; Michigan Engineering Co., Detroit; National Engineer, Chicago; National Steam Pump Co., Upper Sandusky, Ohio; Peerless Rubber Co., New York City; Wm. Powell Co., Cincinnati; Power, New York City; Practical Engineer, Chicago; Quaker City Rubber Co., Philadelphia; G. L. Simonds, Chicago; S. K. F. Ball Bearing Co., Hartford, Conn.; Southern Engineer, Atlanta, Ga.; Standard Chemical Co., Kalamazoo; Standard Oil Co., Whiting Ind.; Vacuum Oil Co., Detroit; Valvoline Oil Co., Chicago; Wheeler & Blaney Co., Kalamazoo; Wickes Boiler Co., Saginaw, Mich.; J. T. Wing & Co., Detroit.

The Badgers in Convention

ANNUAL MEETING OF WISCONSIN STATE ASSOCIATION HELD AT FOND DU LAC, AUG. 3, 4 AND 5

ALL in all, and spite of the continual downpour on the second day, it was a mighty good time the boys had at Fond du Lac.

Little more than the registration of delegates and the official opening of the Exhibit Hall in the Armory of Co. E, was accomplished the first day of the convention. On Friday, however, things assumed a more business-like aspect, and by 9 o'clock in the morning steam had been turned on and the wheels set in motion. After listening to addresses by the Mayor of the city, Chas. Bindrich, State President, H. F. Wetters and Frank Givens, President and Secretary, respectively, of the local Business Men's Association; F. W. Raven, National Secretary, and J. G. Beckerleg, Past National President, the delegates turned their attention to the more strictly business affairs of the meeting.

Upon recommendation of the educational committee, the delegates voted against any appropriations for the coming year along this line, and thereby to increase the funds available for expenses to be incurred by a newly appointed license committee ordered to draft and present a bill regarding the licensing of stationary engineers at the next session of the State Legislature.

Although the majority of state associations have voiced their disapproval of having the national convention held bi-annually instead of annually, the many letters received from local associations advocating such a change caused the delegates to instruct the committee having charge of this work to continue another year.

The number of delegates reported present at the last business session was 22.

After all matters coming before the convention had been acted upon, the election of officers took place. B. J. Miller, of Milwaukee, was chosen for president; J. R. Weyher, of Stevens Point, for vice-president; R. Fenn, of Sheboygan, secretary; H. R. Dormann, of Madison, treasurer; L. E. Sweet, of Fond du Lac, conductor; F. Seegert, of Racine, doorkeeper, and C. Bindrich, of Milwaukee, state deputy.

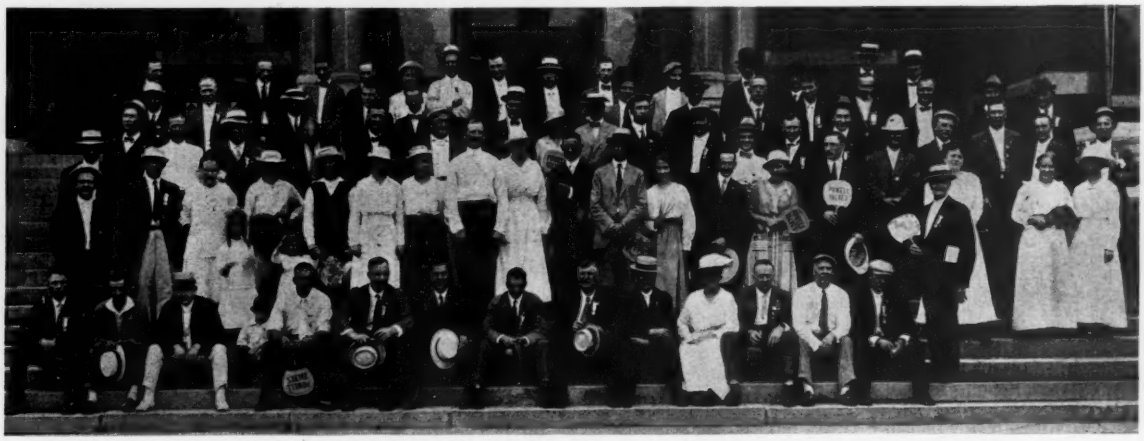
A trip of inspection to the extensive shops of the Soo Line at North Fond du Lac an illustrated lecture by E. D. Anderson, of the Nordberg Manufacturing Co., on the Uniflow steam engine, and a short talk with practical demonstrations on ammonia as applied to mechanical refrigeration, by W. Classman, of Milwaukee, constituted the educational features of the convention.

Friday afternoon the Exhibit Hall was deserted and all matters engineering forgotten. The Engineers and Exhibitors, arrayed in battle garb, met upon the field at League Park, and there determined which side was entitled to the baseball trophy the coming year. Much to the chagrin of the Exhibitors, their opponents won both trophy and honor on a score of 5 to 12.

A sumptuous banquet was attended by delegates, guests, exhibitors and ladies, followed by the installation of newly elected officers and dancing.

THE EXHIBITS

The spacious auditorium of the Armory served well as an exhibit hall, and the booths, which were decorated in white and trimmed with the national colors, were tastefully arranged along the outside walls of the hall with an additional section occupying the center. Among the exhibitors were: The V. D. Anderson Co., Cleveland, O.; Julius Andrae & Sons Co., Milwaukee, Wis.; Acheson Graphite Co., Milwaukee, Wis.; Bowers Rubber Works, San Francisco, Cal.; Chain Belt Co., Milwaukee, Wis.; Crandall Packing Co., Chicago; Cyclone Grate Bar Co., Milwaukee, Wis.; Dearborn Chemical Co., Chicago; M. H. Detrick Co., Chicago; The Edward Valve & Mfg. Co., Chicago; The Garlock Packing Co., Palmyra, N. Y.; Hawkeye Compound Co., Chicago; Hills-McCanna Co., Chicago; Hulson Grate Co., Keokuk, Iowa; Jenkins Bros., New York; H. W. Johns-Manville Co., New York; Keystone Lubricating Co., Chicago; The Lunkenheimer Co., Cincinnati, O.; National Engineer, Chicago; The National Steam Pump Co., Upper Sandusky, O.; National Tube Co., Pittsburgh, Pa.; Newton-Johnson, Milwaukee, Wis.; Peerless Rubber Mfg. Co., Chicago; The Perolin Co. of America, Chicago; The Wm. Powell Co., Cincinnati O.; Power, New York; Practical Engineer, Chicago; Southern Engineer, Atlanta, Ga.; Viscosity Oil Co., Milwaukee, Wis.



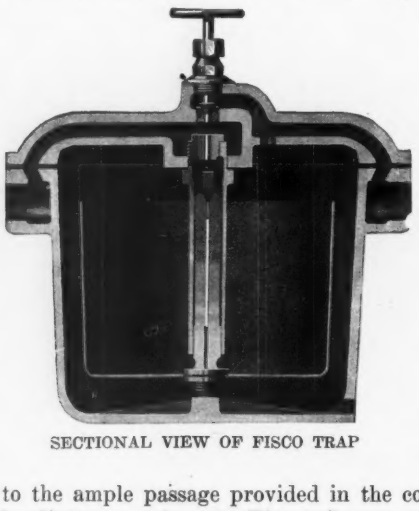
GROUP AT FOND DU LAC CONVENTION

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

Sensitive Steam Trap

CONDENSATION flows continuously into the Fisco Nason Pattern steam trap, and as it overflows into the noncollapsible bucket float, the float sinks, opening the discharge valve to which it is connected. The pressure under which the trap is operating then blows the condensation out of the float, which restores the buoyancy and causes the discharge valve to close. But the float always retains a sufficient quantity of condensation to provide water seal and keep the valves steam tight.



SECTIONAL VIEW OF FISCO TRAP

Due to the ample passage provided in the construction of the discharge valve, the Fisher Governor Co., of Marshalltown, Iowa, which makes the Fisco-Nason trap, claims that there is little friction. This trap is made in 5 sizes, to correspond with pipe connections, ½, ¾, 1, 1¼, and 1½ in.

Sarco Thermo Switch

TO OPERATE an electric switch, a modification of the Sarco temperature regulator for steam, water, and gas valves has been designed and placed on the market by the Sarco Co., Inc., Woolworth Bldg., New York. This new apparatus combines the expansion element of the ordinary Sarco Regulator with a specially designed switch, as shown in the accompanying sketch. It is intended to furnish a means of operating electrically a switch for controlling a supply of current for heating or a motor for distribution of hot air or for any other purpose requiring the control of an electric circuit by temperature changes.

Shown in the sketch is an instrument which has a calibrated scale from 58 deg. to 78 deg. F., and is intended to operate the switch with a change of approximately 2 deg. in temperature. It can be constructed for any temperature up to 325 deg. F.

Serving as an operating medium is a heavy hydrocarbon oil which, on expansion in a brass tube, compresses a Sarco spiral tube inserted in the oil. This spiral tube, which is the same as that used in Sarco Steam Traps and Temperature Regulators, is capable of withstanding pressures up to 2000 lb., but a special safety device is furnished in the form of a heavy steel spring in the regulating head. Following is a description of the electrical switch: The expansion element pushes a rod out

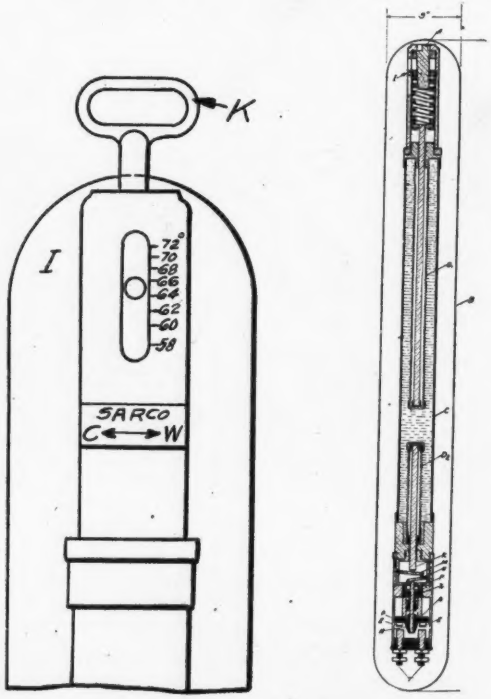


FIG. 1. SCALE OF TEMPERATURE ADJUSTMENT
FIG. 2. CROSS SECTION OF SARCO THERMO SWITCH

of the end of a tube by the expansion of liquid, derived from increase in temperature. The movement is multiplied by levers and a motion is obtained sufficient to operate the snap switch even with slight changes in temperature. .

As shown in the cross-sectional view, Fig. 2, the instrument is in the "hot" position with the plunger extended. As the instrument changes to "cold" position, the rod R is slowly withdrawn into the tube, followed up by the plunger P, which operation is based upon the action of the spring X. The insulating member carrying the switch blade F is held in its illustrated

These tables contain data especially worked out or carefully selected that are vital to your work. preserve them. A handy

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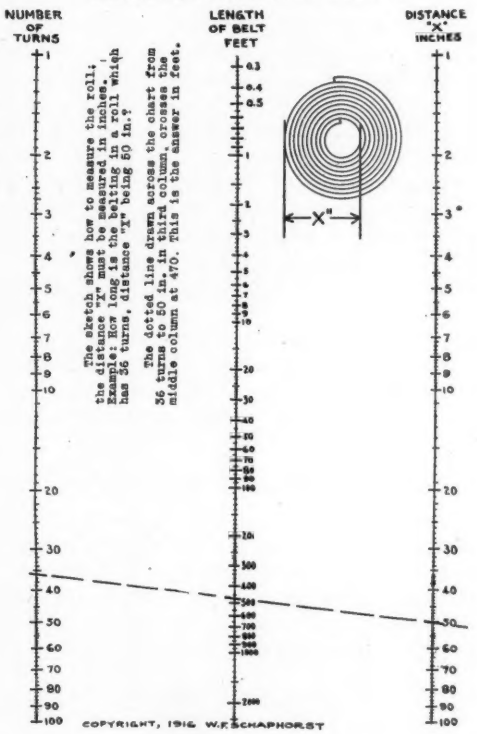
PRACTICAL ENGINEER

LENGTH OF ROLLED-UP BELTS


NUMBER OF TURNS
LENGTH OF BELT FEET
DISTANCE "X" INCHES
The sketch shows how to measure the roll; the distance "X" must be taken in inches. Example: How long is the belting in a roll which has 36 turns, distance "X" being 60 in.?
The dotted line drawn across the chart from 36 turns to 60 in. in third column, crosses the middle column at 470. This is the answer in feet.
"X"
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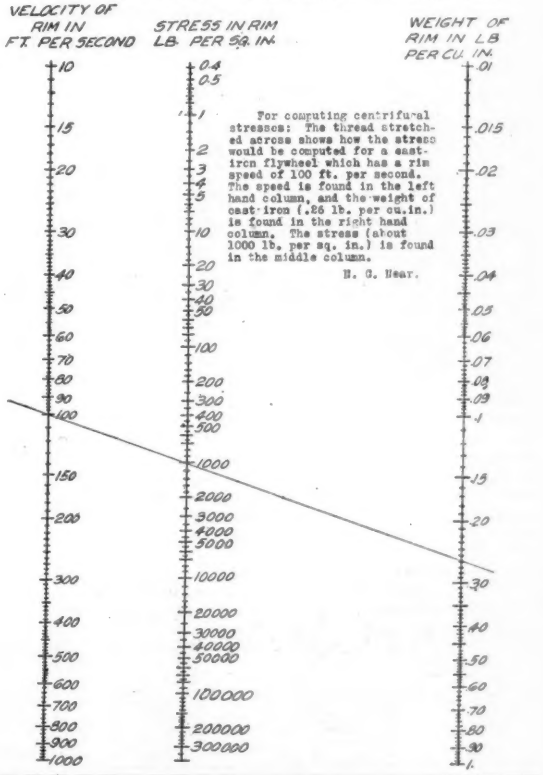
PRACTICAL ENGINEER

CHART FOR COMPUTING CENTRIFUGAL STRESSES


VELOCITY OF RIM IN FT. PER SECOND
STRESS IN RIM LB. PER SQ. IN.
WEIGHT OF RIM IN LB PER CU. IN.
For computing centrifugal stresses: The thread stretched across shows how the stress would be computed for a cast-iron flywheel which has a rim speed of 100 ft. per second. The speed is found in the left hand column, and the weight of cast-iron (.26 lb. per cu.in.) is found in the right hand column. The stress (about 1000 lb. per sq. in.) is found in the middle column.
H. G. Near.

PRACTICAL ENGINEER

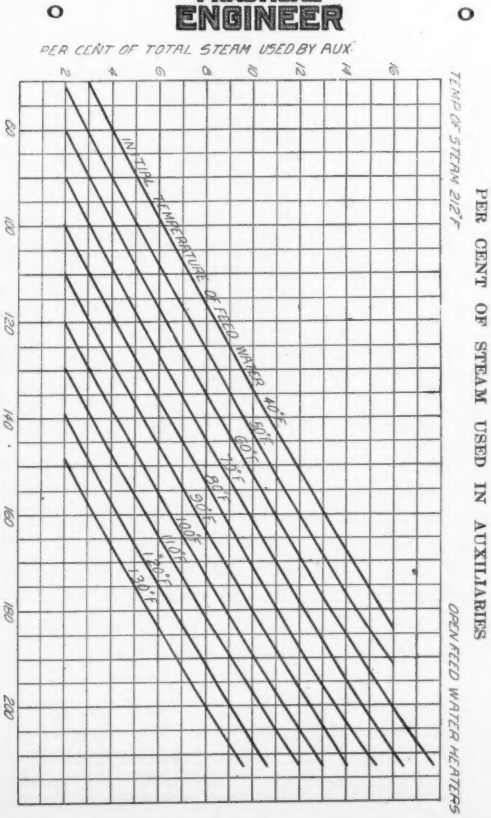


FIG. 1. CHART FOR DETERMINING THE FINAL FEED WATER TEMPERATURE FROM THE INITIAL TEMPERATURE AND PER CENT OF STEAM USED IN AUXILIARIES

PRACTICAL ENGINEER

EQUIPMENT OF STANDARD PANELS

FOLLOWING ARE enumerated the various parts required in the equipment of standard panels for varying services:

Generator or Synchronous Converter Panel, Direct-current, 2-wire System: 1 circuit breaker; 1 ammeter; 1 handwheel for rheostat; 1 voltmeter; 1 main switch (3-pole s.t. or d.t.) or 2 s.p. switches.

Generator or Synchronous Converter Panel, Direct-current, 3-wire System: 2 circuit breakers; 2 ammeters; 2 handwheels for field rheostats; 2 field switches; 2 potential receptacles for use with voltmeter; 3 switches; 1 4-point starting switch.

Generator or Synchronous Motor Panel, 3-phase, 3-wire System: 3 ammeters; 1 3-phase wattmeter; 1 voltmeter; 1 field ammeter; 1 d.p. field switch; 1 handwheel for field rheostat; 1 synchronizing receptacle (4-pt.); 1 potential receptacle (8-pt.); 1 field rheostat; 1 triple-pole oil switch; 1 power-factor indicator; 1 synchronizer; 2 series transformers; 1 governor control switch.

Synchronous Converter Panel, 3-phase: 1 ammeter; 1 power-factor indicator; 1 synchronizing receptacle; 1 triple-pole automatic oil switch; 2 series transformers; 1 shunt transformer; 1 watthour meter (polyphase); 1 governor control switch.

Induction Motor Panel, 3-phase: 1 ammeter; series transformers; 1 oil switch.

Feeder Panel, Direct-current, 2-wire and 3-wire: 1 s.p. circuit breaker; 1 ammeter; 2 s.p. main switches; potential receptacles (1 4-point for 2-wire panel; 1 4-point and 1 8-point for 3-wire panel).

Feeder Panel, 3-wire, 3-phase and single-phase: 3 ammeters; 1 automatic oil switch (3-pole for 3-phase, 2-pole for single-phase); 2 series transformers; 1 shunt transformer; 1 wattmeter; 1 voltmeter; 1 watthour meter; 1 handwheel for control of potential regulator.

Exciter Panel (for 1 or 2 exciters): 1 ammeter (2 for 2 exciters); 1 field rheostat (2 for 2 exciters); 1 4-point receptacle (2 for 2 exciters); 1 equalizing rheostat for regulator.

—Marks' Mechanical Engineers' Handbook.

WEIGHTS OF STEAM ENGINE FLYWHEELS

(Values of C in the formula: Weight in lb. = h.p. × C/kNv^2)

Cut off	Compression*	Single-cylinder engines						Two-cylinder engines			Three-cylinder engines	
		Non-condensing				Condensing		Cranks at 90 deg.			Cranks at 120 deg.	
		Piston speeds in ft. per min.										
		200	400	600	800	200	400	200	400	800	200	800
¼	p	272,690	240,810	194,670	158,200	234,160	174,380	71,960	70,160	70,040	33,810	30,190
¼	0.7p	241,530	209,890	165,450	132,030	206,030	151,680					
¼	0	218,580	187,430	145,400	108,690	173,660	118,350	60,140†	60,140†	60,140†	32,240	31,570
¾	p	242,010	208,200	168,590	162,070	204,210	164,720	59,420	57,000	60,140	33,810	35,140
¾	0.7p	220,280	188,880	151,440	148,540	185,250	148,780					
¾	0	209,170	179,460	136,460	135,260	167,140	133,080	54,340†	54,340†	54,340†	35,500	33,810
½	p	220,760	188,510	165,210	.....	189,600	174,630	49,272	49,150	.....	34,540	36,470
½	0.7p	207,230	176,080	150,710	.....	173,900	164,970	.....	.....	.....	.....	.....
½	0	201,920	170,040	146,610	.....	161,830	151,680	50,000†	50,000†	.....	33,450	32,850
½	p	193,340	174,630	.....	.....	172,690	.....	37,920	35,500	.....	35,260	33,810
½	0.7p	187,670	167,860	.....	.....	165,930	.....	.....	.....	.....	.....	.....
½	0	182,840	167,860	.....	.....	159,990	.....	36,950†	36,950†	.....	32,370	32,370

h.p. = indicated horsepower of the engine.

c = constant given in table above.

k = maximum linear rim velocity, ft. per sec. — minimum rim velocity ÷ average rim velocity = coefficient of energy fluctuation, the acceptable values of which are as follows: Pumps, 1/20 to 1/30; machine shops, 1/35 to 1/40; looms and paper mills, 1/40; spinning mills, 1/60; direct-current generators (lighting), 1/150; alternating-current generators, 1/300.

N = r.p.m.

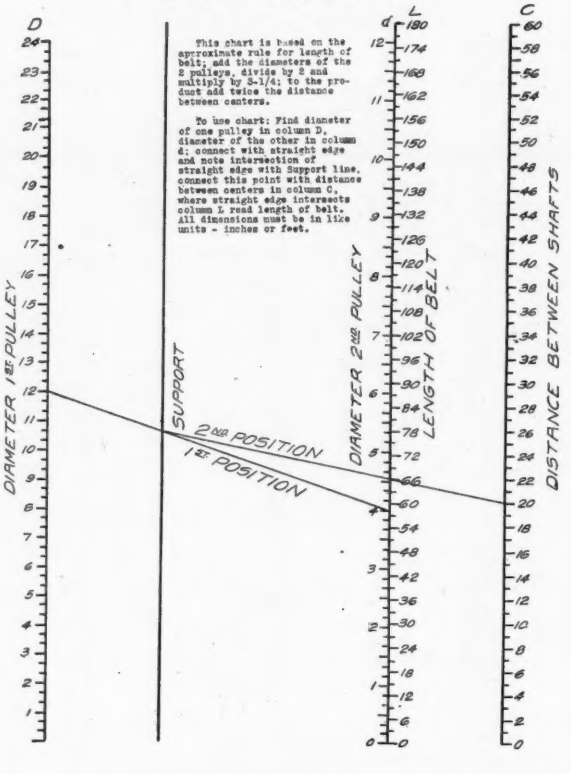
$v.$ = average rim velocity, ft. per sec.

*p = compression to initial steam pressure; 0.7p = compression to 0.7 × initial steam pressure; o = no compression.

*Mean values.

—Marks' Mechanical Engineers' Handbook.

LENGTH OF OPEN BELT


This chart is based on the approximate rule for length of belt; add the diameters of the 2 pulleys, divide by 2 and multiply by 3-1/4; to the product add twice the distance between centers.
To use chart: Find diameter of one pulley in column D, diameter of the other in column d; connect with straight edge and note intersection of straight edge with Support line, connect this point with distance between centers in column C, where straight edge intersects column L read length of belt. All dimensions must be in like units - inches or feet.
D
DIAMETER 1ST PULLEY
SUPPORT
2ND POSITION
1ST POSITION
d
DIAMETER 2ND PULLEY
L
LENGTH OF BELT
C
DISTANCE BETWEEN SHAFTS

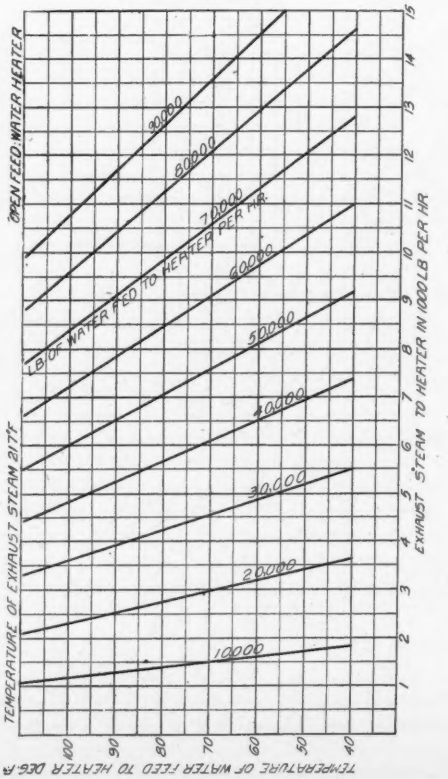
BREAKER CAPACITY TABLE

The following table shows the ampere capacity of breakers to be used for the protection of motors. Necessarily average and not extreme values of motor efficiency had to be selected, but in general the table will be found conservative.

H.P.	D. C. Voltage 110	D. C. Voltage 220	D. C. Voltage 500	Single Phase A. C. Voltage 110	Single Phase A. C. Voltage 220	Two Phase—4 Wire A. C. Voltage 110	Two Phase—4 Wire A. C. Voltage 220	Two Phase—4 Wire A. C. Voltage 440	Three Phase—3 Wire A. C. Voltage 110	Three Phase—3 Wire A. C. Voltage 220	Three Phase—3 Wire A. C. Voltage 440
1	10	5	3	15	10	10	5	3	10	5	3
2	30	10	5	30	15	15	10	5	15	10	5
3	30	15	10	45	30	30	15	5	30	15	10
5	45	30	10	60	30	30	15	10	45	20	10
7.5	60	30	20	80	45	45	30	10	45	30	20
10	60	45	30	100	60	60	30	20	60	30	20
15	150	60	30	150	80	80	45	20	80	45	30
20	150	80	45	200	100	100	60	30	100	60	30
25	200	100	45	200	100	150	60	45	150	80	45
30	300	150	60	300	150	150	80	45	150	80	45
50	400	200	80	500	300	300	150	80	300	150	80
75	600	300	150	600	400	400	200	100	400	200	100

—Roller-Smith Co.

FIG. 2. AMOUNT OF EXHAUST STEAM REQUIRED TO HEAT WATER

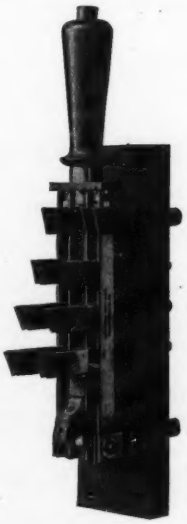


position by the brass seat against which it rests, therefore, the plunger head H is withdrawn slowly through this insulating member, expanding the spring S, which is an endless coil spring free to roll from one end to the other of the plunger head, carrying with it the insulating member, which carries the switch contacts. As the plunger draws through this switch member, the spring S expands, and as the point of greatest diameter of the plunger head passes through the center of the spring S, the compression of the spring S causes it to travel down the plunger head, carrying with it the insulating member carrying the switch arms, which then hop over and locate themselves on the terminal posts T, thus closing the circuit. This condition is maintained until the process reverses itself by application of a warmer temperature.

This switch is perfectly safe to operate on a 220-volt d.c. or a.c. circuit and will carry 5 amp. Its action is quick and positive. The device will work with lamps in series without causing a flicker.

Motor Starting Knife Switch

FOR USE as a simple and inexpensive method of starting rotary converters from the direct-current end and direct-current motors of large capacity having starting conditions that will permit cutting out the starting resistance in 4 steps, the Westinghouse Electric & Mfg. Co. has developed a line of motor starting



WESTINGHOUSE MOTOR STARTING KNIFE SWITCH

knife switches of which the one illustrated is typical. These switches are for use on circuits up to 600 v., and are made in 2 types for starting capacities from 300 to 3600 amp. They are intended for starting conditions only, being rated in terms of the starting current. They will, however, carry ¼ their rated current continuously. Unless the full-load current is only ¼ of the starting current rating, a short-circuiting line switch or circuit-breaker should be used to carry the running load.

These motor-starting switches have 4 sets of contacts of such length that the switch blade makes contact with each set in succession. Each switch has 4 blades, a construction that allows of ample ventilation and reduces the depth of the switch from the switchboard.

To prevent large machines from being started too quickly by throwing the switch through all the positions without stopping on any one positon, a ratchet device is provided on the switches for starting capacities of from 1200 to 3600 amp. This device has a stop for each position, and it is necessary to release this stop before passing to the next position, thus insuring that the machine being started has time to accelerate as the resistance is cut out.

These switches are furnished with terminal lugs and are arranged for mounting on panels from 1¼ to 2 in. thick.

Catalog Notes

SPRAGUE ELECTRIC WORKS Bulletin No. 48,906 describes 1-ton and ½-ton electric hoists for lifting and conveying, and illustrates their use in machine shops, ice plants and elsewhere.

TROLLEY LINE MATERIAL, including clinch ears, trolley splicers, frogs and suspensions, is described and illustrated in descriptive leaflet No. 3881, just issued by the Westinghouse Electric & Mfg. Co.

THE WM. POWELL CO.'S Catalog No. 10, second edition, contains 40 pages on Powell valves and other Powell products, with a supplement of useful tables and information.

BULLETIN NUMBER 45,603, just issued by the General Electric Co., describes that company's graded shunt resistance multigap lightning arresters for alternating-current constant potential circuits. This description is contained in a pamphlet of 32 pages, which is illustrated by descriptive diagrams and halftone illustrations. The action of the arrester is described in detail and the various designs are illustrated. These arresters may be arranged for indoor and outdoor installation. The bulletin describes and illustrates also choke coils for use with these arresters.

THE INGERSOLL-RAND CO. has recently issued 3 new bulletins as follows:

Form 3036 on Turbo Blowers. These blowers are suitable for any air service where the capacity requirements range from 3000 to 35,000 cu. ft. of free air per minute at pressures of 1 to 2½ lb. and are particularly adapted to such work as foundry cupola blowing; atomizing oil for oil burners; supplying blast to various kinds of heating and annealing furnaces; blowing air for water gas generators; pneumatic conveying systems and for ventilating purposes.

Form 3029 describes the "Ingersoll-Rogler" Class "ORC" Corliss steam driven air compressors of the duplex type with the steam cylinders next to the frames and separated from the air cylinders by open distance pieces. This type of machine is offered in 4 different combinations of cylinders.

Form 4120 describes the Leyner-Ingersoll water drills, explains the construction in detail and illustrates the different types, including numerous installation views.

Copies of these bulletins are free on request to the nearest branch office.

CRESCENT BELT FASTENERS catalog, with new price list, was recently received from Crescent Belt Fastener Co., 381 Fourth Ave., New York.

OVALHOLE PACKING is discussed in a folder just issued by the Hollow Center Packing Co. of Chicago. The merits of this rod packing for steam, ammonia, hot water, cold water, and in cotton oil mills are told in a convincing manner.

THE ECONOMY Produced by Using Reversing Planer-Motors on Machines Having Reciprocating Motion, is the title of descriptive leaflet (No. 3554-A) just issued by the Westinghouse Electric & Mfg. Co., in which this subject is thoroughly discussed, illustrations and a summary of machine tool operating expense being given.

AS AN EFFICIENT and practical method for the preparation of glue, the electric glue pot ranks as one of the most important applications of electricity to the industrial heating field.

Bulletin No. 49,103, just issued by the General Electric Co., describes its two styles of electric glue pots, namely: the jacketless and the water jacketed glue pots. Each pot is illustrated, and the bulletin contains illustrations of installations, and tables of the various sizes in which the pots are manufactured, together with catalog numbers for ordering.

BULLETIN NO. 28, recently published by the Nordberg Manufacturing Co., covers a line of poppet valve engines which includes 3 types—namely, full poppet, poppet-uniflow and poppet-Corliss. It is pointed out that the engine best suited for the purpose is recommended in each case. For ordinary noncondensing service, the high-speed full poppet valve engine shows the highest efficiency. For condensing service, 2 types of engines are offered—Nordberg poppet-uniflow and Nordberg poppet-Corliss, the former being an engine with uniflow cylinder design; that is, exhaust ports in the cylinder barrel and poppet steam valves, and the latter a compound engine with full poppet high-pressure cylinder and a Corliss valve low-pressure cylinder. The poppet-uniflow engine is particularly adapted to widely fluctuating loads on account of its flat steam consumption characteristic.

The bulletin is well illustrated, showing many installations of engines, and also details of construction of the valves, valve operating gear, removable cages, cylinders and head. Particular attention is drawn to the construction of the latter, which contains all cored passages and ports, the cylinder proper being a simple cylindrical casting which is free to expand and contract with temperature changes.

Following the discussion of the different types of engines and their construction, a number of pages are devoted to test results. This is followed by a short discussion of the application of poppet valve engines to compressors, pumps and ice machines. The remaining part of the bulletin is devoted to the illustration and description of the frame, bearings, rods, cranks and receiver. Copies of this bulletin are being distributed on request.

PRACTICAL ENGINEER

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CENTRIFUGAL FEED PUMP WANTED—New or second-hand, 100 g.p.m. against 200-ft. head; direct connected to motor, 3 ph., 60 cycle, 550 v. Mr. Larkin, Revere Rubber Co., Chelsea, Mass. 8-15-1

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Miscellaneous

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Sparks From The Advertising Pages

We have come to look upon advertising as a means to an end and that end is the building up of business through the increase of sales. But there are other benefits that are not always accredited to its powerful influence. For instance, the awakening of the human mind to the unnatural and detrimental physical effect of certain social conditions; the stimulation of interest in the worthy charities of the day; the interest manifest and the good accomplished by the transportation companies and many commercial enterprises in teaching "Safety First." The improvement of sanitary conditions which has affected all—the rich and the poor—the low and the high—the weak and the strong. Indeed that old-time saying, "A city physician can keep his family on his typhoid patients alone," is an expression of the past.

These are just a few of the advantages that advertising has brought us and which are sometimes overlooked by those who see only its commercial possibilities.

"Printers' Ink" in a recent editorial gives us further thoughts on the part advertising is playing in social progress.

"Advertising is a factor, and in our opinion a very important factor, in the general movement towards higher standards of conduct in all branches of human activity.

"Not so many years ago—it is within the memory of men who are yet living—the business man was definitely placed in the lower ranks of the social hierarchy. That a tradesman might also be a gentleman was hardly conceivable. And being in a measure a social pariah, the tradesman quite frequently acted up to his reputation. He was shrewd, tricky and generally followed the doctrine of *caveat emptor*. And why not, when the buyer considered himself socially superior to the man with whom he bargained?

"It is not an accident that the overturning of that condition, and the rise of the "mere business man" in the social scale, has been accompanied by the development of modern advertising. The pioneers in advertising were attacking social tradition, though they probably did not realize it. They began to spread a better knowledge of business among members of the more genteel professions, and they began, moreover, to advertise a higher moral standard than *caveat emptor*. Grant that at first they assumed a virtue which they did not possess—they soon began to practice it. The improvement in business morals which has come along with advertising is familiar enough to need no argument. When the history of human progress in our days comes to be written, we may be quite sure that advertising will have no inconspicuous place in it. And though such reflections may have little practical value in solving the problems of today, it may be a satisfaction to consider that our industry faces forward, and that we are not vainly endeavoring to turn back the hands of the clock."